INDIA

CARDIOVASCULAR DISEASES AND ITS RISK PROFILE

(Prevalence, Current Capacity and Epidemiological Leads in CVD Programmes)

1. Background

According to the World Health Report 2002, cardiovascular diseases (CVD) will be the largest cause of death and disability in India by 2020 (1). Much of this enormous burden is already evident in urban as well as semi-urban and slum dwellings across India, where increasing lifespan and rapid acquisition of adverse lifestyles related to demographic transition are thought to have contributed to rising prevalence of chronic disease determinants like smoking, physical inactivity, improper diet, stress etc. and their ensuing outcomes such as obesity, hypertension, and type 2 diabetes. This accelerated epidemiological transition has resulted in urban Indians experiencing heart attacks, strokes and type 2 diabetes at least a decade earlier than the western population, with nearly a fifth of hospital-based patients being less than 40 years of age (2-6). This has significant implications for the national productivity.

There is also an increasing trend for reversal in the socio-economic gradient for CVD (as already manifest in developed nations), with the poor and disadvantaged having an equal, sometimes higher, burden of CVD and its risk factors (7-9). Added to this is the lack of awareness and understanding regarding CVD, resulting in a large proportion (one-third to a half or more) of those with risk factors like hypertension and diabetes remaining undetected and even a lesser fraction achieving adequate control (Unpublished data from the ICMR task force study no. 1988-0608A and the "Establishment of Sentinel Surveillance System for CVD in Indian Industrial Populations" Study). Similarly, compliance and adherence to therapies among those with established vascular disease is poor, exposing them to a very high risk of future vascular events including sudden death (6, 10).

While infectious and malnutrition-related illnesses continue to be a major problem, in many parts of India the additional burden of CVD will severely strain an overstretched, ill-prepared and resource constrained health infrastructure (2). In this scenario, control of CVD will require a comprehensive prevention programme comprising policies and measures for promoting awareness and healthy lifestyles in the general population as well as strategies for cost-effective identification and treatment of high-risk individuals. Integrated prevention programmes incorporating health promotion, surveillance and risk reduction instruments prevent premature death and avert diversion of resources to expensive and technology-intensive treatment for established vascular disease, and have been successful in developed as well as developing country settings (e.g. Finland and Mauritius) (11,12). Whether such programs are successful depends on many factors, but mainly on the background burden of CVD and its risk factors.

2. Burden of CVD in India

2.1 Introduction:

Several studies have suggested that the burden of CHD is rising in India. These projections are based on three types of data: (a) through cause specific mortality sample surveys in the rural and urban areas (rural cause of death survey and urban death certifications), (b) prevalence data (through surveys of communities scattered over time and place) and (c) hospital based data (based on admission patterns in primary health centers and tertiary care centre).

2.2 Prevalence Studies:

Most prevalence data are based on ECG criteria or the Rose angina questionnaire. Gupta et al, in their review of published studies in 1996, reported an increase in the prevalence of coronary heart disease (CHD) from 1% in 1960 to 9.6% in the year 1995 among urban Indian residents. Similarly, the prevalence in rural residents rose from 2% in 1974 to 3.74% in 1995 (13). In their latest systematic review (14), they report the prevalence of CHD obtained mainly through cross sectional surveys to be 3-4 % in rural areas and 8-10% in urban areas among individuals aged above 20 years. Based on these data they estimate that there were approximately 29.8 million patients with CHD in the year 2003. Of these 14.1 million resided in urban areas, while the remaining 15.7 million were rural residents. With an estimated 10% attrition and event rates they projected an annual new event or death to occur in 2.9 million persons per year with nearly 1.5 million people dying due to CHD every year (14).

The current studies highlighting the prevalence and incidence for Coronary Heart Disease, Rheumatic Heart Disease and Rheumatic Fever, Stroke in India have been captured in tables below. The tables display study location, type of study (urban/ rural) respective age- group and gender, criteria for diagnosis, study setting and corresponding references. A graphical presentation has been made on the available data wherever appropriate , however marked heterogeneity among studies mostly due to the varying time periods of data collection should not be discounted .(For complete details on inclusion criteria please refer Appendix III, references – refer.xls).

Prevalence of CHD among Male & Female in Urban Indian Population from Community Based Cross- sectional studies								
S.No.	**Location**	**Year**	**Age- Gp**	**Prevalence (%)**		**Sample Size**		**Criteria**
				Male	**Female**	**Males**	**Female**	
1	Chandigarh	*1968	30+	6.54	6.72	1361	669	B
2	Haryana - Rohtak	* 1975	30+	4.53	2.29	1407	-	-
3	Jaipur	1992-95	20+	5.96	10.54	1415	797	C
4	Delhi	1991-94	35-64	10.9	10.3	1439	1582	C
5	Tamil Nadu	1994	40+	3.5	4.5	532	421	C
6	Chennai	1996-97	20+	6.2	14.8	518	657	C
7	Rajasthan	2001	20+	6.18	10.12	550	573	C

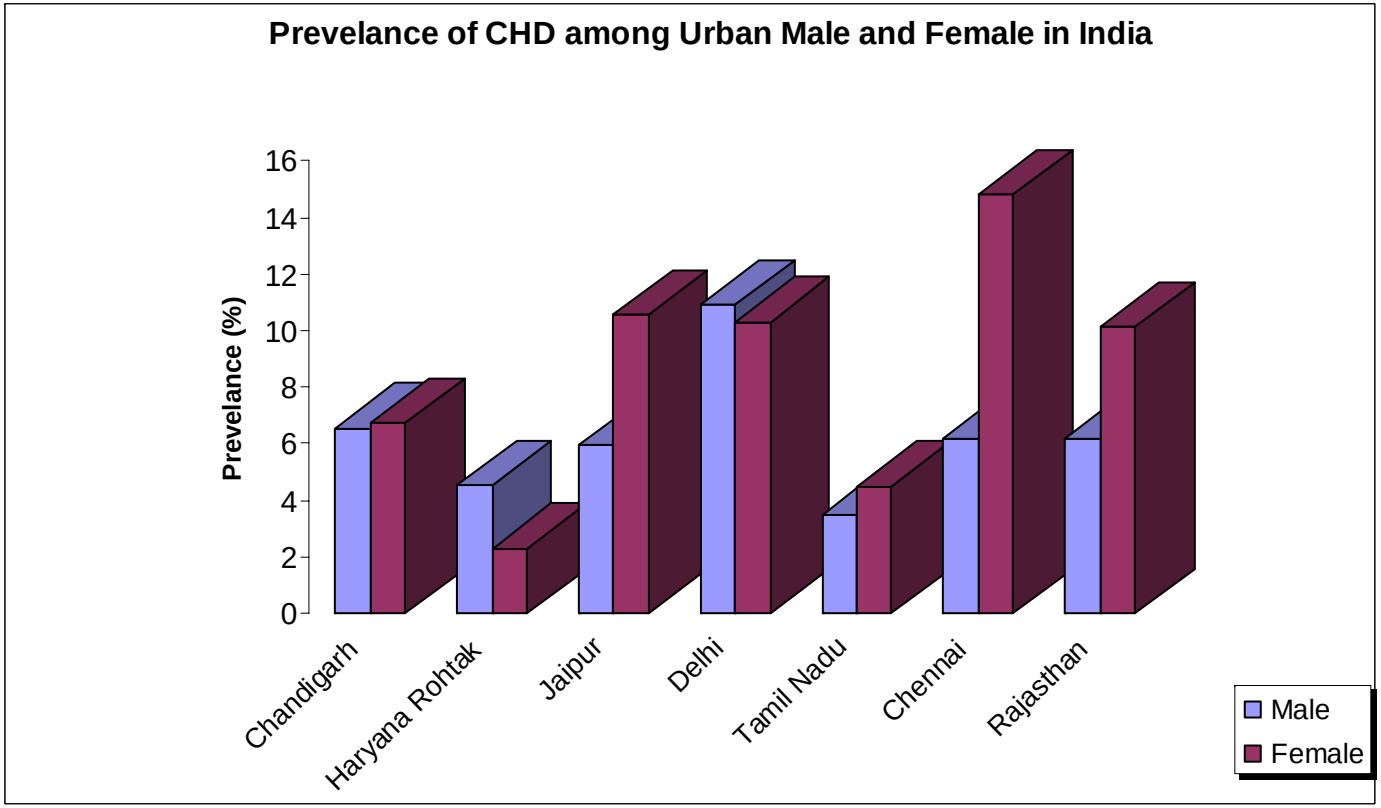
A-Clinical history or + for Rose questionnaire

B-ECG changes

C- A & or B

- Unknown

** Year of publication*


Prevelance of CHD among Urban Male and Female in India
Prevelance (%)
16
14
12
10
8
6
4
2
0
Chandigarh
Haryana Rohtak
Jaipur
Delhi
Tamil Nadu
Chennai
Rajasthan
Male
Female

Overall Prevalence of CHD in Urban Indian Population							
S.No.	**Location**	**Year**	**Age- Gp**	**Prevalence**	**Sample Size**	**Criteria**	**Setting**
					M/F		
1	UP Agra	*1961	20+	5.3	672/229	B	CB
2	UP Varanasi	1986-87	30+	6.48	648	C	BHU campus
3	Delhi	1991-94	35-64	10.6	3021	C	CB
4	Jaipur	1992-95	20+	7.59	2212	C	CB
5	Tamil Nadu	1994	40+	3.9	953	C	CB
6	Kerala	*1995	25-65	13.9	460	U	CB
7	Chennai	1996-97	20+	11	1175	C	CB
8	Rajasthan	2001	20+	8.19	1123	C	CB

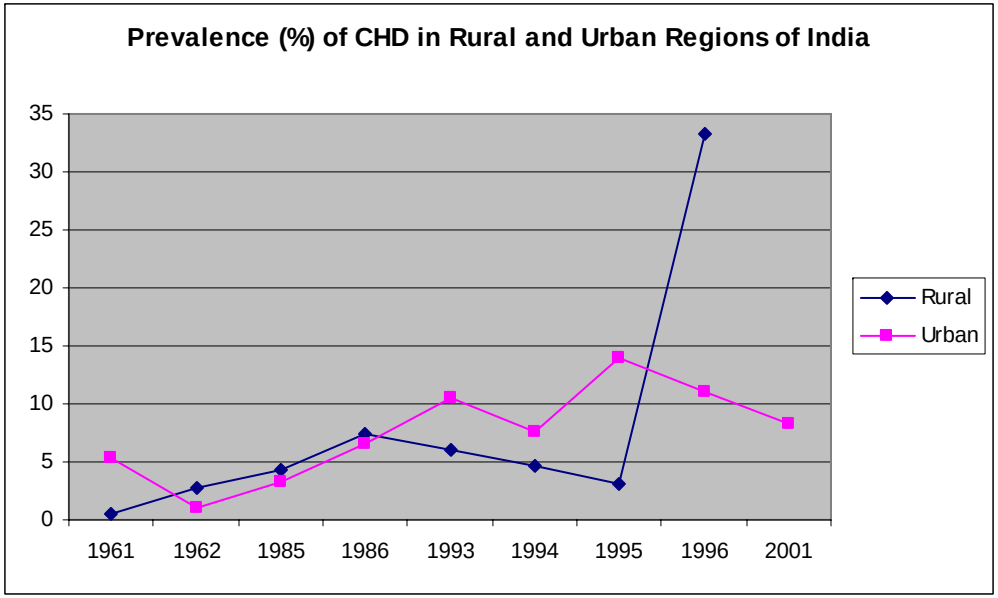
A-Clinical history or + for Rose questionnaire

B-ECG changes

C- A & or B

- Unknown

** Year of publication*


Prevalence (%) of CHD in Rural and Urban Regions of India
35
30
25
20
15
10
5
0
1961
1962
1985
1986
1993
1994
1995
1996
2001
Rural
Urban

Overall Prevalence of CHD in Rural Indian Population						
S. No.	**Location**	**Year**	**Age- Gp**	**Prevalence**	**Sample Size**	**Criteria**
1	Maharashtra Sevagram	*1988	30+	4.36	2443	-
2	Kerala, Trivandrum	1990-91	25+	7.4	1130	C
4	Haryana	1991-94	35-64	6.1	2423	C
5	Rajasthan	*1994	20+	4.61	1150	C
6	Punjab Pohir	*1994	30-69	3.1	1100	B

A-Clinical history or + for Rose questionnaire
B-ECG changes
C- A& or B
- unknown
** year of publication*

Incidence of CHD in Urban Indian Population from Community Based Longitudinal study							
S.No.	**Location**	**Year**	**Age- Gp**	**Incidence**		**Setting**	
				Male	**Female**		
1	Rohtak (U)	1977-78	>=30	6	2	-	
2	Delhi (U)	1990-91	25-64	4	2	CB	
3	Gujarat (R)	1987-88	30-62	6		CB	
		1991-92			3		

CB = Community Based

Prevalence of Rheumatic Heart Disease In Indian Population					
S.No.	**Place**	**Year**	**Age-Gp**	**Prevalence** (%)	**Sample Size**
1	Ballabgarh	1982-90	5-14	0.1	13509
2	Varanasi	1982-90	5-14	0.54	12190
3	Vellore	1982-90	5-14	0.29	13509
4	Raipurrani	1988-91	5-14	0.21	31200
5	Delhi	1984-94	5-9	0.39	40000
6	Ludhiana	1987	6-16	0.13	6005
7	Gujrat,Anand	1986	8-18	0.203	11346
8	Kanpur	2000	7-15	0.454	3963
9	Tamil Nadu ,Vellore	2001-02	6-18	0.068	229829

Incidence of Rheumatic Fever in India (per 1000)					
S.No.	**Place**	**Year**	**Age group**	**Incidence**	**Sample Size**
1	Delhi	1984-94	5-10	0.38	40000
2	Gujarat,Anand	1986	8-18	0.18	11346
3	Ludhiana	1987	6-16	0.70	6005
4	Raipurani	1988-91	5-15	0.54	31200
5	Kanpur	2000	7-15	0.75	3963

Prevalence (%) of Stroke per 1000 in Indian Population (community based study)									
				Prevalence					
S.No.	**Place**	**Type**	**Year**	**Male**	**Female**	**Sample Size**		**Setting**	**Criteria**
						Male	Female		
1	Vellore	R	1968-69	0.69	0.45	258576	-	-	U
2	Mumbai	?	1985	4.57	3.97	14010	-	CB	Q
3	Kashmir	R	1986	3.10	1.65	20284	17002	CB	U
4	Calcutta	U	1988-89	1.25	1.70	26210	24081	CB	U
5	Bangalore	R & U	1993-95	1.68	1.32	52399	50158	CB	U
6	Haryana, Rohtak	-	*1998	0.97	0.86	14337	10612	CB	U

U-Urban, R-Rural , Q-Questionnaire

* denotes publication year

? Unavailable / unknown

Prevalence of Stroke per 1000 in Indian Population (industry based data)									
S.No.	**Place**	**Type**	**Year**	**Male**	**Female**	**Sample Size**		**Setting**	**Criteria**
						Male	Female		
1	Bangalore	U	2001-03	0.4	0.6	2527	1260	IP	History
2	Coimbatore	U	2001-03	0.6	-	1684	-	IP	History
3	Delhi	U	2001-03	0.9	0.2	2354	1042	IP	History
4	Hyderabad	U	2001-03	0.8	0.5	2765	546	IP	History
5	Ludhiana	semi U	2001-03	0.1	-	1999	-	IP	History
6	Nagpur	semi U	2001-03	0.1	0.3	2970	1832	IP	History
7	Pune	semi U	2001-03	0.7	0.5	1886	1734	IP	History
8	Trivandrum	U	2001-03	0.3	0.3	1556	904	IP	History
9	Lucknow	U	2001-03	0.5	0.1	2805	2085	IP	History

U-Urban, R-Rural , IP Industrial Population

* denotes publication year

- Unavailable / unknown

2.3 Hospital based data:

Thirty year trends of (1960 -1990) hospital admissions reveal that admissions due to coronary disease have increased from 5% of hospital admission to almost 30% and rheumatic admission have declined from 52% to 30% (15). Studies from Kerala, Rajasthan also confirm these findings (16, 17).

2.4 Projections based on modeling:

In a response to a systematic review by Ghaffar et al, Gupta projected a more than two fold increase in CHD mortality by the year 2020 as compared to the numbers in 1990 (the projected mortality in 2020 is 2584000 as compared to 1175000 deaths in 1990) (18). Murray and Lopez in their Global Burden of Disease study project 4.8 million CVD deaths by the year 2020 AD, with majority of deaths occurring in middle age (47.7% of all CVD deaths). India will have lost 43.5 million DALYs by the year 2020 due to CVD (19). According to the World Health Report of 2002, deaths due to CHD in India rose from 1.17 million in 1991 to 1.59 million in 2000 and are further expected to rise to 2.03 million by 2010 (1).

2.5 Characteristics of CVD in Indians

The risk of death due to CHD is substantially higher among Indians and this is evident from 'migrant' studies which report a 1.5-3.8 CHD mortality ratio among migrant Indians when compared to the local populations (table 1) (20).

Table 1: Mortality from CHD in South Asians overseas

Groups Contrasted			Age	CHD Mortality Ratio
Singapore	1980-88	S.Asian/Chinese	30-69	3.8
Fiji	1980	S.Asian/ Melanesian	40-59	3.0
Trinidad	1977-86	S.Asian/African	35-69	2.4
South Africa	1985	S.Asian/European	35-74	1.4
England	1979-83	S.Asian/European	20-69	1.5

While there are several similarities, certain characteristics distinguish CVD among Indians as compared to the Western populations. The INTERHEART study, a large case-control study, involving 15152 patients of incident AMI and 14820 age & sex matched controls from 52 countries across the globe demonstrated that the risk imposed by conventional risk factors for AMI among South Asians is similar to the Western populations (21). However, given the background high prevalence of diabetes, impaired glucose tolerance, insulin resistance and metabolic syndrome, the population attributable risk and the individual-absolute risk get magnified manifold.

In addition, with the earlier age at onset and an increased risk of long-term mortality following acute coronary syndromes, the adverse consequence of higher burden of CVD is clearly evident. In 1990, 52.2% of the CVD related deaths in India occurred below the age of 70 years, while the corresponding figure for the developing industrial countries (established market economies) was 22.8% (19). In addition, similar to Western populations, reversal of socioeconomic gradient for CVD has already begun both for CVD and its risk factors. We identified two case-controls (22, 23) and a cross-sectional survey (7) which demonstrates high risk for MI and higher prevalence of CHD among poorer individuals as compared to people from the higher socio-economic status. Similar reversal of socio-economic gradients for CVD risk factors have been demonstrated (table 2-4) (7-9, 24, Unpublished data from ICMR Task Force Study).

Table 2: Prevalence of CVD risk factors in Chennai Urban Population Study (CUPS 4*)*

Risk Factor	Low income	Middle income
Diabetes %	12	6
Impaired fasting Glucose %	7	3
Hypertension %	15	8
Hypercholesterolemia %	24	14
Hyperinsulinemia %	17	7

Table 3: Trends in educational status and coronary risk factors in first (1995) and second (2002) study and absolute change in risk factors in men

Variable	1995 %				2002 %			
	0	1	2	3	0	1	2	3
Smoking	44	52	30	18	54	43	29	24
Diabetes	-	2	0.3	3.1	6.8	8.8	7.9	7.9
Hypertension	29	33	26	30	19	41	38	47
Truncal obesity	50	62	51	61	39	51	68	75
Physical activity	87	71	55	63	89	64	51	43
Obesity	17	21	22	29	13	32	50	54

Education status was classified into four different groups. Group 0: no formal education, Group 1: 1-10 years of schooling, Group II: 11-15 years of schooling, and Group III: >16 years of schooling

Table 4: Educational level and prevalence of tobacco habit in urban Delhi, rural Haryana and Industrial population in sub-urban Delhi

Educational Level	Urban n=1456 Age: 34-65 yrs	Rural n=1070 Age: 35-64 yrs	Industrial n=2273 Age: 22-58 yrs
Illiterate	61.4%	83.3%	78.6%
Semi-Literate	48.6%	88.1%	73.7%
Undergraduate	41.3%	70.3%	52.8%
Graduates / Postgraduates	22.3%	44.2%	35.6%
Period of Surveys: 1990-1998			

The limited affordability to the recent advances in therapy also results in higher death rates among the poor who develop acute coronary syndromes (ACS). Non-affordability and delayed presentation to the hospital following AMI are major reasons for patients not getting thrombolytic therapy in the Indian setting (3-6). Data from the CREATE registry involving 76 hospitals and 13660 patients of ACS suggests a high mortality at 30 days, low rates of intervention and drugs for secondary prevention among the poor (10).

Factors for this increased burden:

Reasons for increased burden of CVD include alteration of age profile and increasing urbanization (25) along with rising rates of diabetes, hypertension, overweight and tobacco consumption (26-28). In India, the life expectancy increased from 32 years in 1947 to 62 years as per current reports and the levels of urbanization too has increased from 17% of population residing in urban areas in 1947 to 28% in 2001 (25).

Studies of Indian migrants suggest that adverse gene-environmental interactions could also play a major role along with programmed susceptibility (Barker's hypothesis) (29). In addition, other non-conventional risk factors may interact with conventional risk factors in enhancing the risk imposed by simple risk factors (28).

To summarize, there is an increase in the burden of CHD, with a higher contribution to CVD mortality and DALY loss, decline in the pre-transitional CVD such as rheumatic heart disease, earlier age of onset of CHD and higher affliction of the poor and less educated.

3. Burden of CVD risk factors in South Asians:

3.1 Introduction

Several cross-sectional studies were initiated in the late 1980s to obtain CVD risk factor prevalence among Indians. Studies that were large and well designed are summarized in table 5. The cross sectional studies that were carried out are of three types:

- Cross-sectional surveys within India;
- Migrant studies comparing South Asian (mainly Indians) to other local population; and
- Comparison of migrants and their relatives living within India.

Table 5: CVD risk factors in 'South Asians': Summing up the evidence

Author	Identified risk factor
Migrant Studies (highlighting non-conventional risk factors)	
McKeigue 1991, 1993 (26,27)	Central obesity; Hyperinsulinemia Glucose Intolerance (Diabetes+ IGT)
Enas 1995 (28)	Dyslipidemia (decrease HDL-cholesterol and increase triglycerides), elevated Lipoprotein 'a'
Anand 2000 (29)	Elevated homocysteine
MIGRANT STUDIES (highlighting conventional risk factors)	
Bhatnagar (London- Punjab)1995 (30)	Conventional Risk Factors are important and have been underestimated.
Shaukat (Case- Control in UK)1995 (31)	
Bhopal (S. Asian groups) 1999 (32)	
Prevalence studies within India	

Pais 1996 (Case-Control) (22)	Smoking; Hypertension
Reddy 1993, 99 (ICMR Task Force Study; 33)	Total Cholesterol: HDL Ratio Waist-Hip Ratio + BMI Dysglycemia + Diabetes
Mohan 2001 (34)	Emphasis on conventional risk factors. High prevalence of IGT

The INTERHEART study estimated that 2 risk factors (the apoA/ apo B ratio and smoking) accounted for 67% of the total PAR. Nine simple risk factors accounted for 90% of PAR in men and women. These risk factors are: smoking, H/o HT or DM, WHR, diet, physical activity, consumption of alcohol, apolipoprotein, and psychosocial factors. The relative risks specific to South Asians which are provided in table 6 below were similar to the other ethnic groups (21).

Table 6: Risk of MI in relation to conventional risk factors among South Asians (INTERHEART STUDY)

Risk factor	Odds Ratio for presence of MI
Smoking	**2.5**
Dyslipidemia	**4**
High BP	**3**
Diabetes	**2.5**
Abdominal obesity	**2.5**
Psychosocial factors	**2**
Fruits/vegetables	**0.7**
Exercise	**0.7**
Alcohol	**0.9**

Although relative risk of CHD imposed by these risk factors were similar, the absolute risk for Indians is still unknown. The absolute risk for South Asians may be higher due to the higher propensity to develop diabetes and metabolic syndrome at lower body weights and abdominal obesity levels as compared to the western counterparts. Combined with the higher risk for death and morbidity following an acute event, and inadequate availability of appropriate therapy for these individuals with heart disease, the social and economic burden imposed by CHD will be enormous for the Indian society.

We provide a brief review of published studies of hypertension, diabetes, tobacco use, body mass index, waist circumference and waist hip ratio and physical activity levels among Indians.

3.2 Hypertension:

The overall prevalence of hypertension has risen from a low of 4.3 in 1963 to as high as more than 50% among specific communities of Kerala and Rajasthan (35). The current prevalence of hypertension is estimated to range between 20-40% in urban adults and 12-17% among rural adults (35). The prevalence rates are confounded by the definition of hypertension, the time periods at which the survey was carried out and the location of this study.

The Atlas of Heart Disease and Stroke has demonstrated a sustained increase in the mean blood pressure levels from a low 120 mmHg to 130 mmHg in the year 1997 as compared to the year 1942 (36). Further modeled data project that 107.3 million men and 106.2 million women will suffer from hypertension by the year 2025. Compounding this high burden is the lack of awareness, insufficient and ineffective treatment among those with known hypertension. For example in urban Chennai the prevalence of HT was 22.8% and 19.7 in male and females respectively. However only 8.3% and 8.2% males and females were aware of HT status and 3.8 and 4.4% were on drug therapy (37). A systematic review of the published studies is provided in appendix IV.

The current studies highlighting the prevalence of Hypertension in India have been captured in tables for High Blood Pressure (refer file Table and graphs.xls). The tables display study location, type of study (urban/ rural) respective age- group and gender, criteria for diagnosis, study setting and the respective references. An attempt has been made to present the data in graphical form, however, the marked heterogeneity among studies due to varying time periods of data collection should not be discounted. Also different definitions for defining hypertension have been used although most of them have based their results on JNC V criteria. (For complete details on inclusion criteria please refer Appendix III, references – refer.xls).

Overall Prevalence of High Blood Pressure in Indian population - Age Group 20-69 (Industry Based data)						
S.No.	**Place**	**Type**	**year**	**M/F**	**Prevalence**	**Sample size**
1	Assam	R	2001-03	M	29.9	1189
		R	2001-03	F	32.7	1213
2	Bangalore	U	2001-03	M	36.8	906
		U	2001-03	F	26.8	790
3	Coimbatore	U	2001-03	M	21.9	1043
		U	2001-03	F	21.2	942
4	Hyderabad	U	2001-03	M	41.0	882
		U	2001-03	F	34.7	406
5	Nagpur	Semi U	2001-03	M	19.5	1408
		Semi U	2001-03	F	12.3	819
6	Trivandrum	U	2001-03	M	30.4	1115
		U	2001-03	F	23.9	897
7	Pune	Semi U	2001-03	M	26.2	1159
		Semi U	2001-03	F	25.4	1143
8	Delhi	U	2001-03	M	27.1	2354
		U	2001-03	F	22.1	1043
9	Lucknow	Semi U	2001-03	M	43.7	943
		Semi U	2001-03	F	31.7	754

U-Urban, R-Rural
* denotes publication year
M-Men, W/F-Women, T-Total
IP-Industrial population
CB-Community based
Criteria >140/90 or History

Prevalence (%)of High Blood pressure Northern and Western Indian Population										
					Prevalence (%)		Overall		Sample Size	
S.No.	Place	Type	Year	Age Gp.	Male	Female	Prevalence	Criteria	M/F	Setting
1	Agra	-	*1963	20+	4	6.6	4.3	>160/95	1408/227	CB
2	Bombay	R	*1959	30-59	-	-	0.52	>160/95	5996	CB
3	Bombay	U	*2004	35+	47.5	48.4	-	JNC VI	88653	CB
4	Chandigarh	U	1993	30+	-	13.1	-	>160/95	1686	CB
5	Delhi	R	1984-87	25-64	4.1	3.3	-	>160/90	3375	CB
6	Delhi	U	2001-03	20-69	27.1	22.1	-	>140/90 or history	2354/1043	IP
7	Gujrat, Surat	U	1994-95	20-59	24.1	-	-	JNC VI	985	IP
8	Haryana	R	1991-94	30-69	13.3	10.4	-	>140/90 or history	548	CB
9	Jaipur	U	2002-03	20-69	51.3	51.3	-	>140/90	226/232	CB
10	Kanpur	U	*1954	18-60	-	-	4.24	>160/95	2262	CB
11	Lucknow	U	2001-03	20-69	43.7	31.7	-	>140/90 or history	943/754	IP
12	Ludhiana	Semi U	2001-03	20-69	26.5	-	-	>140/90 or history	831	IP
13	Moradabad	R	*1998	25-64	-	-	17.00	>140/90	1769	CB
14	Moradabad	U	*1998	25-64	-	-	22.6	>140/90	902	Women in Moradabad city
15	Mumbai	U	*2003	20-69	32.8	39.4	36.4	-	2415	CB
16	Punjab	R	*1985	20+	-	-	2.63	>160/95	3340	CB
17	Rajasthan	R	*1994	20+	15.3	8.4	13.2	>140/90	805/345	CB
18	Rohtak - Haryana	R	*1977	20-69	3.55	3.59	3.57	>160/95	1151/872	CB
19	Rohtak-Haryana	U	*1978	20-69	5.99	7	6.4	>160/95	1151/872	CB
20	Shimla	U	*1998	-	-	-	33	JNC V	7630	Employees in Shimla town
21	UP	R	*1996	30+	5.57	8.82	7.19	-	1572	CB

U-Urban, R-Rural, * denotes publication year, M-Men, W/F-Women, T-Total
IP-Industrial population, CB-Community based

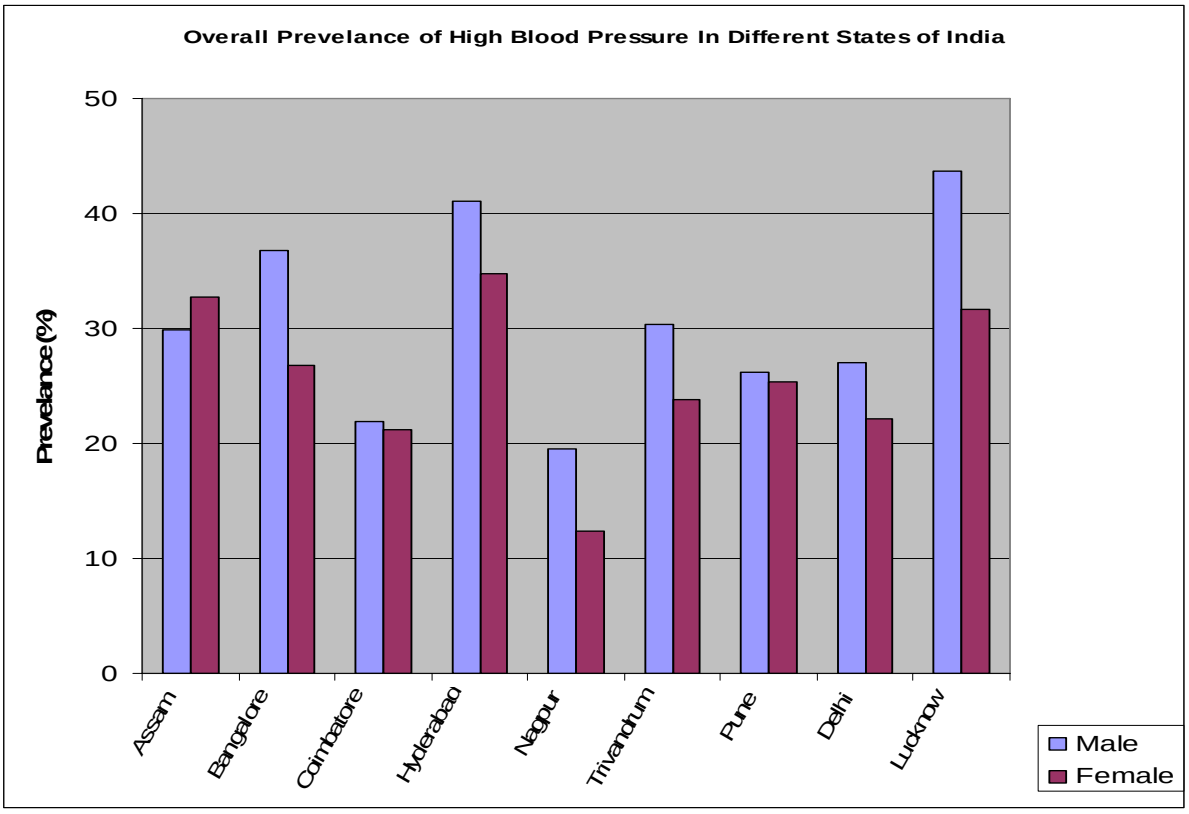
Prevalence of High Blood pressure(%) in Rural Indian Population										
					Prevalence (%)		Overall			
S.No.	Place	Type	Year	Age -Gp.	Male	Female	Prevalence	Criteria	Sample Size	Setting
1	Bombay	R	*1959	30-59	-	-	0.52	>160/95	5996	CB
2	Delhi	R	1984-87	25-64	4.1	3.3	-	>160/90	3375	CB
3	Haryana	R	1991-94	30-69	13.3	10.4	-	>140/90 or history	548	CB
4	Trivandrum (Coastal)	R	1998	30-64	35	48	41.5	>140/90	3426	CB
5	Trivandrum (Highland)	R	1998	30-64	26	30.1	28.1	>140/90	3426	CB
6	Trivandrum(Midland)	R	1998	30-64	33.5	29.9	31.6	>140/90	3426	CB
7	Moradabad	R	*1998	25-64	-	-	17.00	>140/90	1769	CB
8	Nagpur	R	*1993	30-70	4.85	3.17	4	>160/95	448	CB
9	Punjab	R	*1985	20+	-	-	2.63	>160/95	3340	CB
10	Rajasthan	R	*1994	20+	15.3	8.4	13.2	>140/90	805/345	CB
11	Rohtak - Haryana	R	*1977	20-69	3.55	3.59	3.57	>160/95	1151/872	CB
12	UP	R	*1996	30+	5.57	8.82	7.19	-	1572	CB

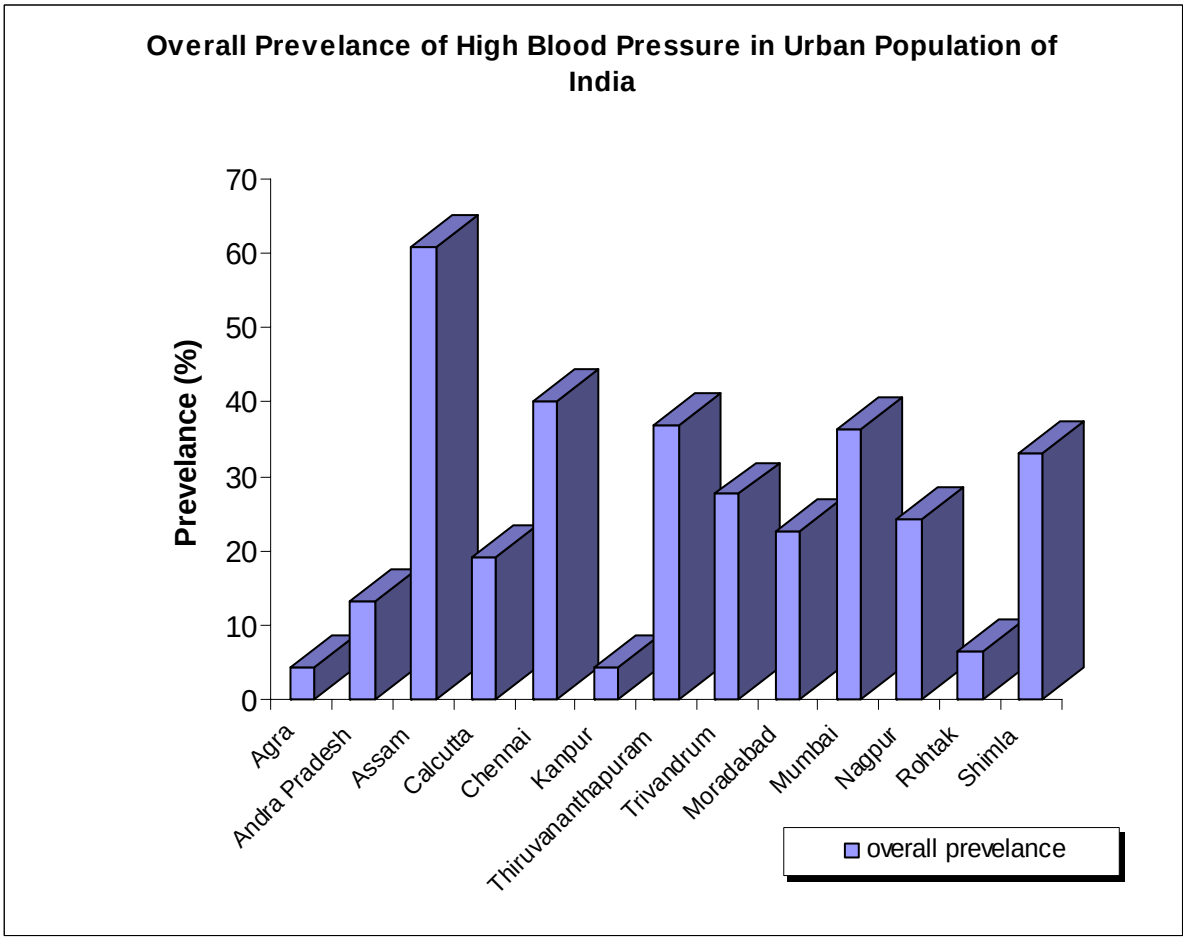
R-Rural
* denotes publication year
M-Men, W/F-Women, T-Total
CB-Community based

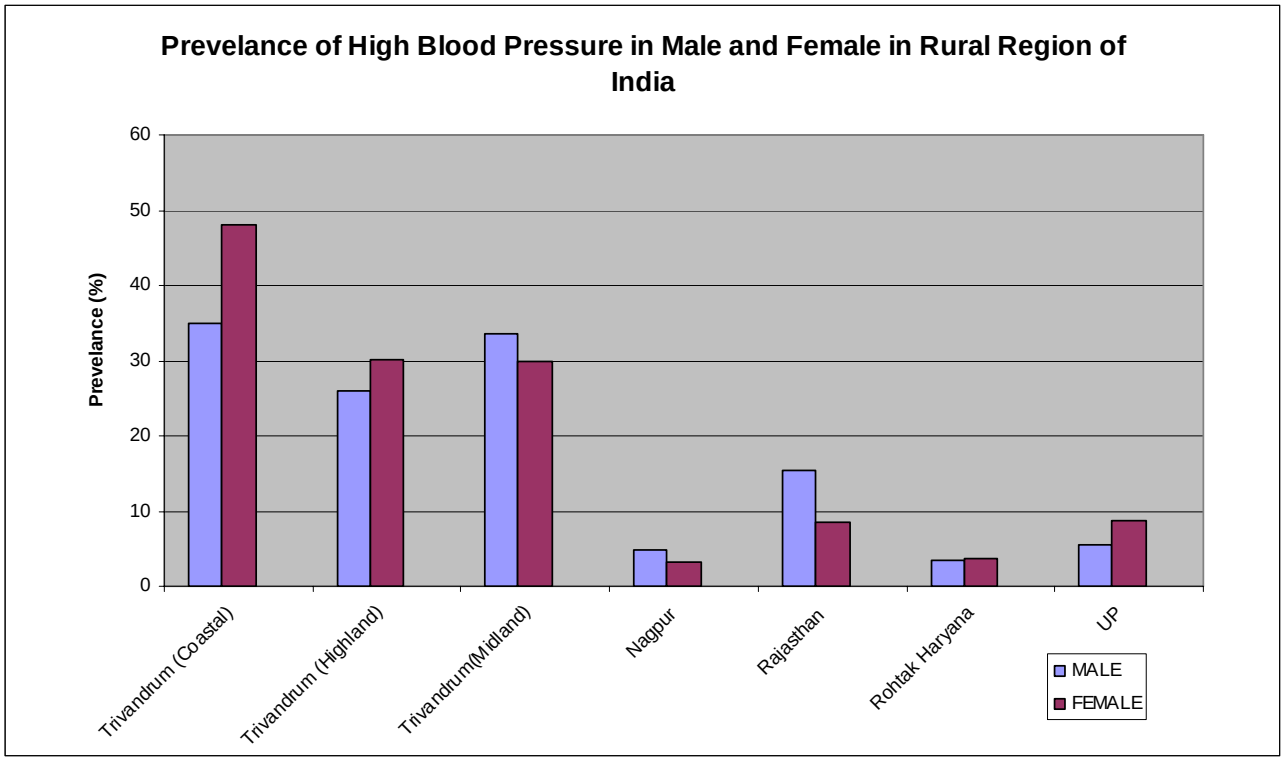
Prevalence (%) of High Blood pressure Urban Regions of India										
					Prevalence (%)		Overall			
S.No.	Place	Type	Year	Age Gp.	Male	Female	Prevalence	Criteria	Sample Size	Setting
1	Agra	-	*1963	20+	4	6.6	4.3	>160/95	1408/227	CB
2	Andhra pradesh	-	*2002	20-70+	19	28	28.00	>140/90	3307	political party workers
4	Assam	-	*2002	30-69	-	-	60.8	>140/90 or history	512/ 503	CB
5	Bombay	U	*2004	35+	47.5	48.4	-	JNC VI	88653	CB
6	Calcutta	U	*1998	25-64			19.1	>140/90	365	CB
7	Chandigarh	U	1993	30+	-	13.1	-	>160/95	1686	CB
8	Chennai	U	1999-00	40-90			40	>140/90	1748 LIG, 635 HIG	CB
9	Delhi	U	2001-03	20-69	27.1	22.1	-	>140/90 or history	2354/1043	IP
10	Gujrat, Surat	U	1994-95	20-59	24.1	-	-	JNC VI	985	IP
11	Jaipur	U	2002-03	20-69	51.3	51.3	-	>140/90	226/232	CB
12	Kanpur	U	*1954	18-60	-	-	4.24	>160/95	2262	CB
13	Lucknow	U	2001-03	20-69	43.7	31.7	-	>140/90 or history	943/754	IP
14	Ludhiana	Semi U	2001-03	20-69	26.5	5.6	-	>140/90 or history	831/18	IP
15	Moradabad	U	*1998	25-64	-	-	22.6	>140/90	902	Women in Moradabad city
16	Mumbai	U	*2003	20-69	32.8	39.4	36.4	-	2415	CB
17	Nagpur	U	*1998	30-70+			24.2	>140/90	405	CB
18	Rohtak-Haryana	U	*1978	20-69	5.99	7	6.4	>160/95	1151/872	CB
19	Shimla	U	*1998	-	-	-	33	JNC V	7630	Employees in Shimla town

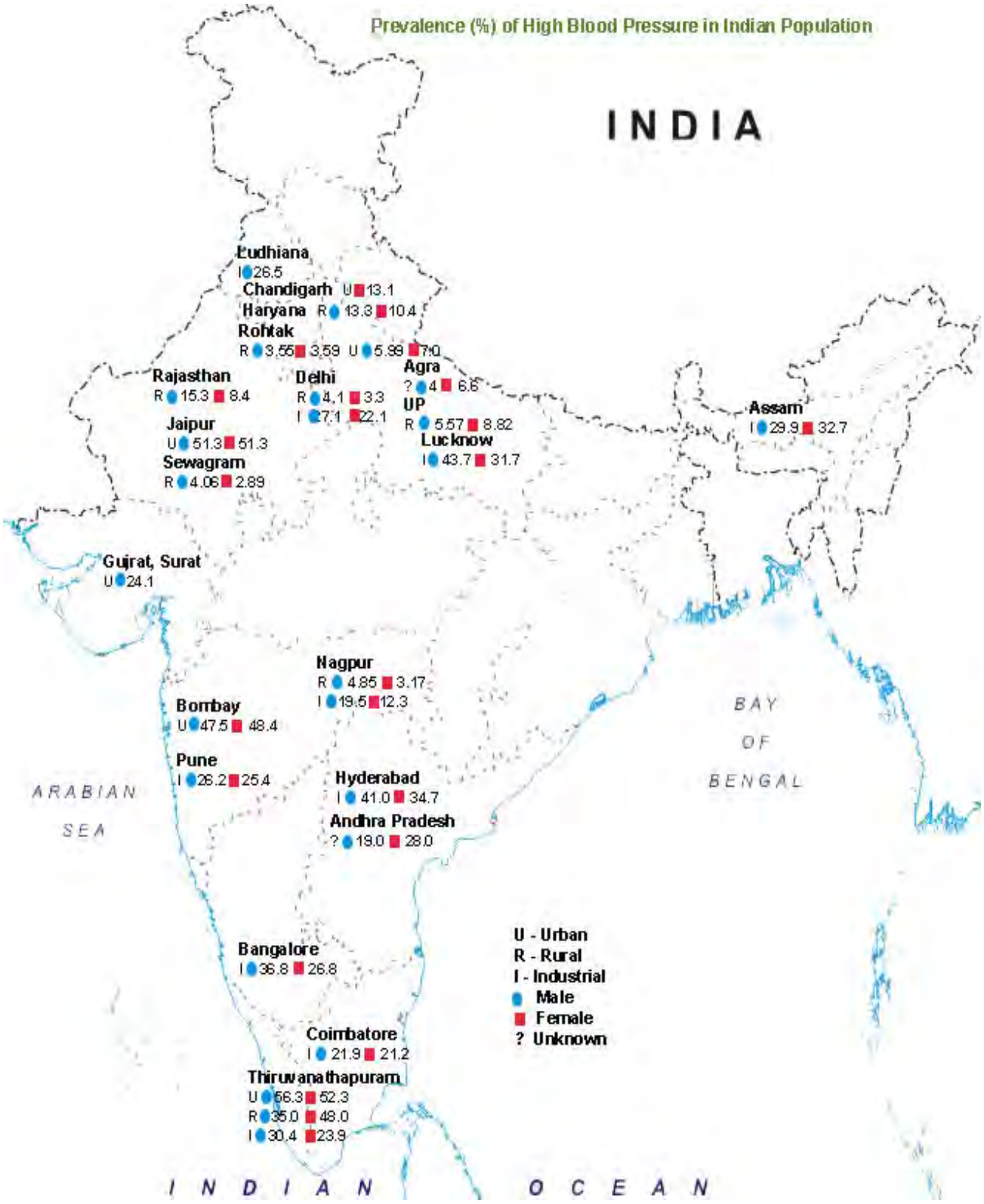
U-Urban, R-Rural
* denotes publication year
M-Men, W/F-Women, T-Total

IP-Industrial population
CB-Community based


Overall Prevelance of High Blood Pressure In Different States of India
Prevelance(%)
50
40
30
20
10
0
Assam
Bangalore
Coimbatore
Hyderabad
Nagpur
Trivandrum
Pune
Delhi
Lucknow
Male
Female


Overall Prevelance of High Blood Pressure in Urban Population of India
Prevelance (%)
70
60
50
40
30
20
10
0
Agra
Andra Pradesh
Assam
Calcutta
Chennai
Kanpur
Thiruvananthapuram
Trivandrum
Moradabad
Mumbai
Nagpur
Rohtak
Shimla
overall prevelance


Prevelance of High Blood Pressure in Male and Female in Rural Region of India
Prevelance (%)
60
50
40
30
20
10
0
Trivandrum (Coastal)
Trivandrum (Highland)
Trivandrum(Midland)
Nagpur
Rajasthan
Rohtak Haryana
UP
MALE
FEMALE


Prevalence (%) of High Blood Pressure in Indian Population
INDIA
Ludhiana
I 26.5
Chandigarh U 13.1
Haryana R 13.3 10.4
Rohtak
R 3.55 3.59 U 5.99 7.0
Rajasthan
R 15.3 8.4
Jaipur
U 51.3 51.3
Sewagram
R 4.06 2.89
Delhi
R 4.1 3.3
I 17.1 22.1
Agra
? 4 6.6
UP
R 5.57 8.82
Lucknow
I 43.7 31.7
Assam
I 29.9 32.7
Gujrat, Surat
U 24.1
Nagpur
R 4.85 3.17
I 19.5 12.3
Bombay
U 47.5 48.4
Pune
I 26.2 25.4
Hyderabad
I 41.0 34.7
Andhra Pradesh
? 19.0 28.0
Bangalore
I 36.8 26.8
Coimbatore
I 21.9 21.2
Thiruvanathapuram
U 56.3 52.3
R 35.0 48.0
I 30.4 23.9
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
U - Urban
R - Rural
I - Industrial
Male
Female
? Unknown

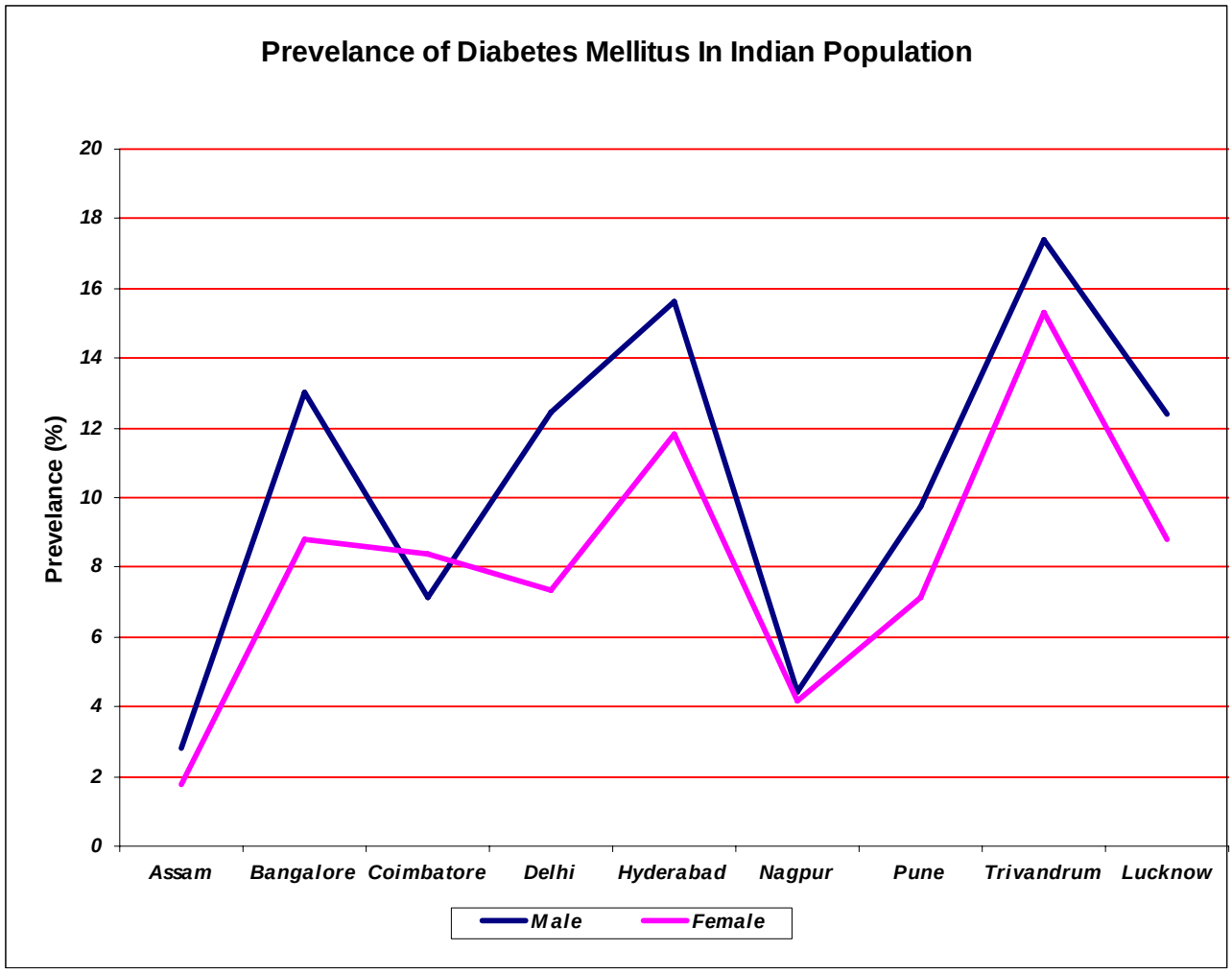
3.3 Diabetes

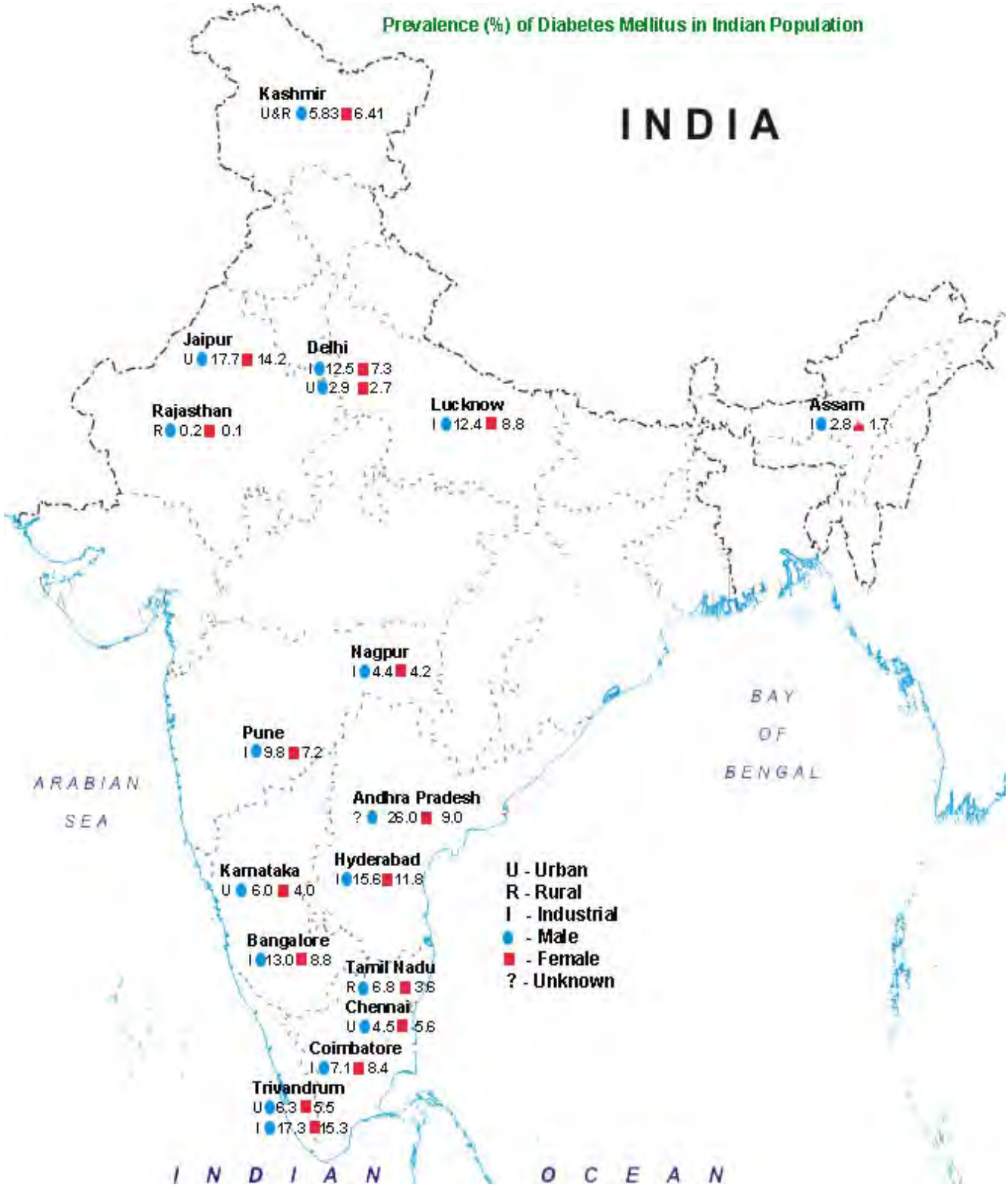
India has been declared as the country with the largest number of diabetics in the world (38). Modeled data project that 57.2 million individuals will have clinical diabetes by the year 2025 (38). The prevalence of diabetes and IGT increased by almost one and a half fold in the year 2000 as compared to the base year of 1989 (13.9% vs 8.3% for diabetes and 16.7% and 8.3% for IGT) in an urban population of South India (39). Based on our review, the current overall prevalence of diabetes is estimated to be approx. 3% and 12% in rural and urban areas, respectively. The prevalence of metabolic syndrome also shows a similar urban-rural gradient with urban prevalence ranging between 24.9% to 30% and rural prevalence between 4.4% and 11.0% using the NCEP ATPIII criteria (Appendix Vb). The systematic review of the published epidemiological studies on diabetes in Indians is provided in appendix V.

The current studies highlighting the prevalence for risk factor Diabetes and Blood Glucose level in India have been captured in table for Diabetes (refer file Table and graphs.xls). The tables have been constructed in similar format as for CHD, Hypertension and elsewhere in the report. (For complete details on inclusion criteria please refer Appendix III, references – refer.xls).

Prevalence (%) of Diabetes Mellitus In Indian Population											
						Prevalence		Sample Size			
S.No.	Place	Type	Year	Age-Gp	Male	Female	Overall	M/F	Criteria	Setting	Remarks
1	Andhra Pradesh	R	*1989	20-84	-	-	1.6	9563	History	CB	**
2	Bangalore	U	2000	>20	-	-	12.4	1359	WHO criteria	CB	***
3	Calcutta	U	2000	>20	-	-	11.7	2378	WHO criteria	CB	***
4	Chennai	U	2000	>20	-	-	13.5	1668	WHO criteria	CB	***
5	Hyderabad	U	2000	>20	-	-	16.6	1427	WHO criteria	CB	***
6	Jaipur	U	2002-03	>20	17.7	14.2	-	226/232	FBS>126mg/dl or history	-	-
7	Karnataka, Kundremukh	U	1985	>20	6	4	5	346/332	WHO criteria 1985	IP	-
8	Kashmir	U&R	*2000	40-90	5.83	6.41	6.14	-	WHO criteria 1985	CB	-
9	Kerala	U	1998-99	>20	16.3	16.3	-	-	FPG>125mg/dl or evidence of treatment	CB	-
10	Ludhiana	R	*1994	>=30	-	-	4.6	623/477	RBS >180mg/dl or history	CB	-
11	Mumbai	U	2000	>20	-	-	9.3	2084	WHO criteria	CB	***
12	New Delhi	U	2000	>20	-	-	11.6	2300	WHO criteria	CB	***
13	Rajasthan	R	1991-93	>20	0.2	0.1	0.2	1982/1166	History	CB	-
14	Tamil Nadu Chennai	U	*2001	>20	4.5	5.6		8659/8120	history	CB	-
15	Tamil Nadu, North Arcot	R	1990	>20	6.8	3.6	4.9	161/252	WHO criteria 1985		
16	Trivandrum	U	1998-99	>20	6.3	5.5	5.9	1610/2289	WHO CRITERIA 1985(FBS>139mg% or PPPG>199mg%, or history)	CB	

**FBS>5.6mmol/l or Post 1-h glucose value>=7.8mmol/l or Post 2-h glucose value>=6.7mmol/l
***Age standardized


Prevelance of Diabetes Mellitus In Indian Population
Prevelance (%)
20
18
16
14
12
10
8
6
4
2
0
Assam
Bangalore
Coimbatore
Delhi
Hyderabad
Nagpur
Pune
Trivandrum
Lucknow
Male
Female


Prevalence (%) of Diabetes Mellitus in Indian Population
INDIA
Kashmir
U&R 5.83 6.41
Jaipur
U 17.7 14.2
Delhi
I 12.5 7.3
U 2.9 2.7
Rajasthan
R 0.2 0.1
Lucknow
I 12.4 8.8
Assam
I 2.8 1.7
Nagpur
I 4.4 4.2
Pune
I 9.8 7.2
Andhra Pradesh
? 26.0 9.0
Karnataka
U 6.0 4.0
Hyderabad
I 15.6 11.8
Bangalore
I 13.0 8.8
Tamil Nadu
R 6.8 3.6
Chennai
U 4.5 5.6
Coimbatore
I 7.1 8.4
Trivandrum
U 6.3 5.5
I 17.3 15.3
U - Urban
R - Rural
I - Industrial
- Male
- Female
? - Unknown
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN

Metabolic syndrome in Indian Population

The earliest study[43] on prevalence of Metabolic Syndrome in India was done in the urban areas of Delhi and rural Haryana and the prevalence was 30% and 11% respectively during 1992-94 (criteria: ATP III). Later, Ramachandran et al[72] (modified ATP III criteria) documented a higher prevalence of metabolic syndrome (41%) in 1995 and Deepa et al[124] reported 11.2% prevalence (criteria: European group for study of insulin resistance-HOMA model) in urban Chennai during 1996-97. Gupta et al[125] reported 25% prevalence (ATP III criteria) in Jaipur. The Sentinel surveillance project[102] in Indian Industrial population illustrated 27% prevalence (ATP III criteria) during 2001-03. Misra et al[58] carried out a study among the urban slum population in Delhi, reported 30% prevalence (own criteria) of metabolic syndrome.

The current studies highlighting the prevalence of Metabolic Syndrome in India have been captured in table for Metabolic Syndrome (refer file Table and graphs.xls). The tables have been constructed in similar format as for CHD, Hypertension and elsewhere in the report. (For complete details on inclusion criteria please refer Appendix III, references – refer.xls).

Prevalence (%) of Metabolic syndrome in India based on cross sectional studies												
						Prevalence			Sample Size			
S.No.	Place	Type	Year	Age-Gp	Criteria	Male	Female	Total	Male	Female	Total	Setting
1	Delhi	U	1992-94	35-64	ATP III	33.4	26.8	30	1394	1465	2859	CB
					ATP III WC>94	33.4	33.5	34	1394	1465	2859	CB
2	Haryana	R	1992-94	35-64	ATP III	10.6	11.6	11.1	548	637	1185	CB
					ATP III WC>94	11.6	12	11.8	548	637	1185	CB
3	Tamil Nadu, Chennai	U	1995	20-75	ATP III & WC>90/85	46.5	36.4	41	258	217	475	CB
4	Tamil Nadu, Chennai	U	1996-97	>=20	HOMA model	-	-	11.2	-	-	1262	CB
5	Rajasthan	U	2001	20+	ATP III	18.4	30.9	24.9	550	573	1123	CB
6	All over India	-	2001-03	20-69	ATP III	20.9	36.3	26.6	-	-	19973	IP
7	Assam	R	2001-03	20-69	ATP III	21.5	18	-	1190	1213	2403	IP
8	Bangalore	U	2001-03	20-69	ATP III	24.7	46.3	-	906	790	1696	IP
9	Coimbatore	U	2001-03	20-69	ATP III	17.4	43	-	1100	989	2089	IP
10	Delhi	U	2001-03	20-69	ATP III	18.8	32.2	-	2354	1043	3397	IP
11	Hyderabad	U	2001-03	20-69	ATP III	26.8	47.3	-	882	407	1289	IP
12	Nagpur	semi-U	2001-03	20-69	ATP III	14.7	22.6	-	1408	819	2227	IP
13	Pune	semi-U	2001-03	20-69	ATP III	12.8	39.6	-	1164	1144	2308	IP
14	Trivandrum	U	2001-03	20-69	ATP III	31.6	47.2	-	1118	897	2015	IP
15	Lucknow	U	2001-03	20-69	ATP III	25.2	33.4	-	944	755	1699	IP

U - Urban, R-Rural

** denotes publication year*

M- Men, F- Female, T- Total

CB-Community based


Prevalence (%) of Metabolic Sydrom in India
INDIA
Haryana
R 10.6 11.6
Delhi
U 33.4 33.5
I 18.8 32.2
Rajasthan
U 18.4 30.9
Lucknow
I 25.2 33.4
Assam
I 21.5 18.0
Nagpur
I 14.7 22.6
Pune
I 12.8 39.6
Hyderabad
I 26.8 47.3
Bangalore
I 24.7 46.3
Tamil Nadu, Chennai
U 46.5 36.4
Coimbatore
I 17.4 43.0
Trivandrum
I 31.6 47.2
U - Urban
R - Rural
I - Industrial
Male
Female
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN

3.4 Tobacco

Tobacco use is widely rampant in India, particularly among the poor and rural residents and is used in a variety of ways which include smoked and smokeless forms. The most popular form of smoking in India is Beedis. Thirty four percent of tobacco produced in India is used for making beedis. It is followed by cigarette smoking which in India is predominantly confined to manufactured cigarettes. Other smoked forms are Cheroots, Chutta, Dhumti, cigars, pipe, hookah, etc. Smokeless forms are also widely prevalent in India. Paan (Betel-Quid) with tobacco is the most popular smokeless form of tobacco use in India. It also includes Paan Masala, Mawa, Gutkha. Tobacco products like Lal Dantmanjan are also used for cleaning the teeth (40).

3.4.1 Prevalence of tobacco use

Tobacco use information comes predominantly from various large local surveys and cross sectional surveys. There are only 3 major national surveys which have collected limited information on tobacco use.

According to the National Family Health Survey-2 (41), 46.5 % of men and 13.8% of women were regular tobacco users while National Sample Survey (42) showed 51.3% and 10.3% of men and women respectively were regular tobacco users (table 7). These surveys show that smoking (compared to smokeless tobacco use) is more common in men while in women smokeless tobacco use is more common.

Tobacco use varies across various regions of India. Smoking among men and women is highest among North-eastern state of Mizoram followed by Meghalaya. Tobacco chewing is also highest among men and women in the state of Mizoram followed by eastern states of Bihar in Men and Orissa in women. Overall tobacco use is higher among men than women in India. Tobacco use is found to be more prevalent among socially disadvantaged groups like scheduled caste and tribes (43).

Women tobacco users not only share the same health risks as men, but are also faced with health consequences that are unique to women, including those connected to pregnancy and cervical cancer. Tobacco use among women is prevalent in all regions of India and among all sections of the society – overall 2.4% of women smoke and 12.0% chew tobacco (44). Smoking prevalence among women is low in most areas due to social unacceptability. According to NFHS 2 (1998-99) data, regions in order of increasing women's tobacco use prevalence are the north, south, west,

central, east, and the northeast (41). Women's tobacco use is higher in the less educated, rural and poorer social strata.

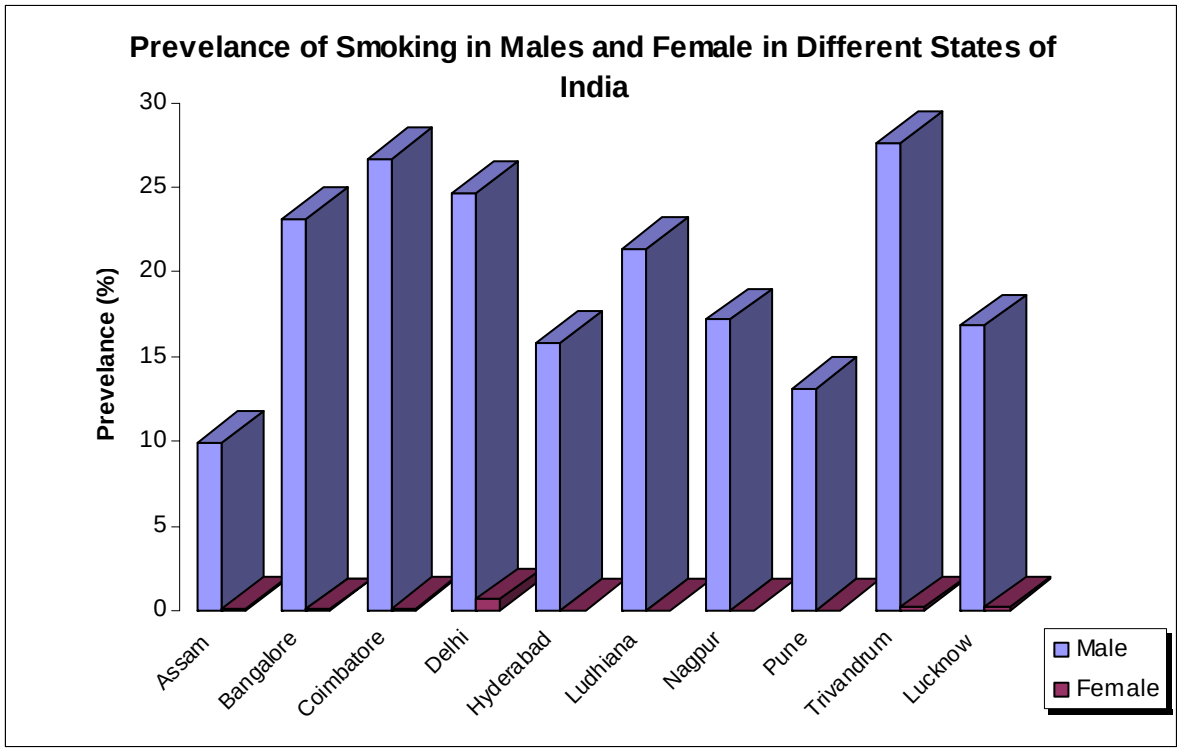
By using the NSSO 1993-1994 age-specific rates, regular consumers of tobacco (aged 10 years and above) were estimated to be 186,482,598 in rural India and 49,337,216 in urban areas. Thus, the total number of tobacco users was 235,819,814 in 2004 (40).

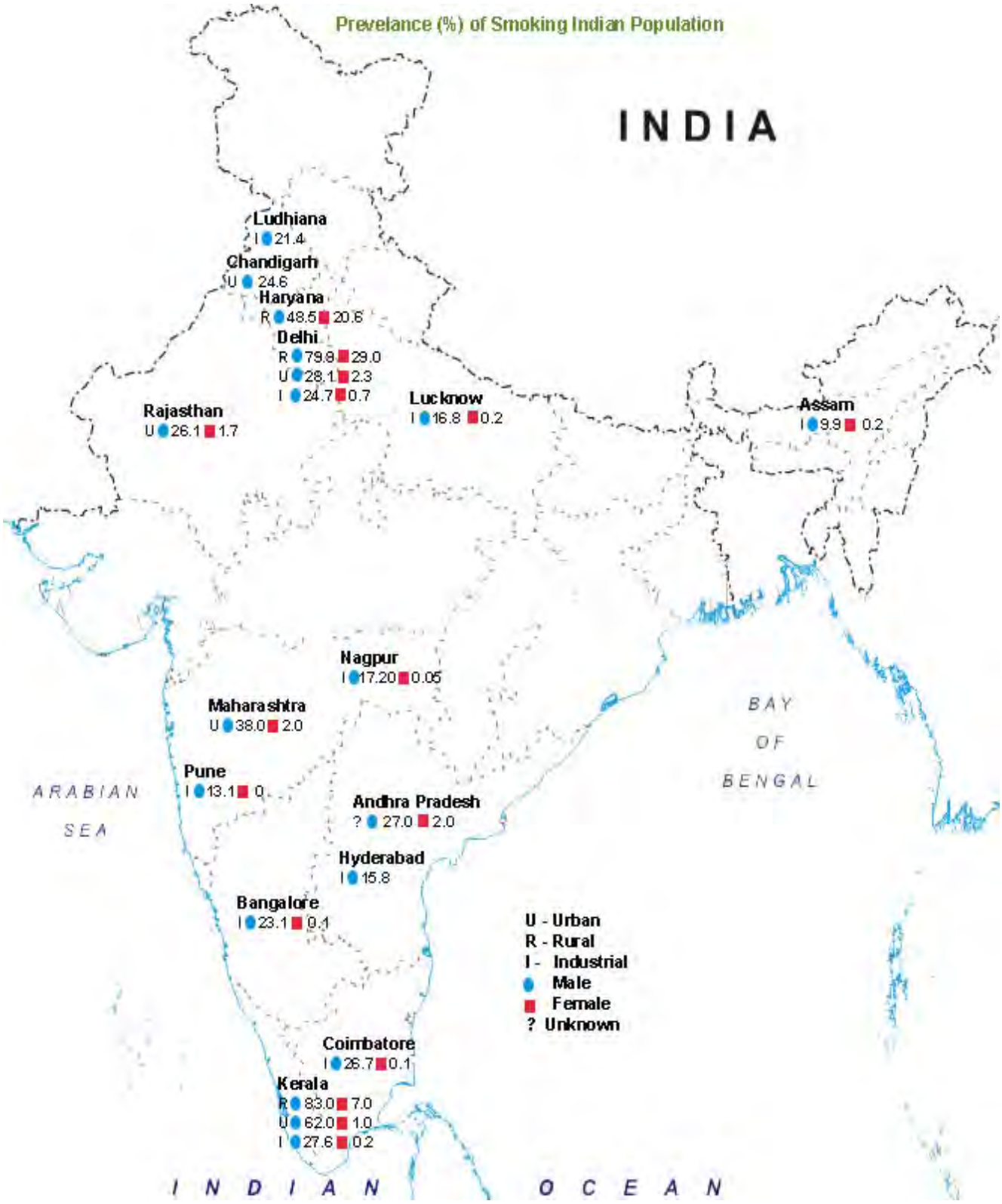
Global Youth Tobacco Surveys done in India between 2000-2004 (unpublished data) show that ever tobacco use (ever consumed any tobacco product) was reported by one-fourth of students (25.1%) and ranged from 4.0% (Himachal Pradesh) to 75.3% (Mizoram). Current use of tobacco (students consuming any tobacco products within 30 days preceding the survey) was reported by 17.5% of students and ranged from 2.7% (Himachal Pradesh) to 63% (Nagaland). Age at which tobacco use is initiated is gradually decreasing with more students initiating below 10 years of age.

The contemporary studies highlighting the prevalence for risk factor Smoking in India have been captured in table for Smoking (refer file Table and graphs.xls). The tables have been constructed in similar format as for CHD, Hypertension and elsewhere in the report. (For complete details on inclusion criteria please refer Appendix III, references – refer.xls).

Prevalence (%) of Smoking Indian Population (Cross-sectional studies)									
S.No.	Place	Type	Year	Prevalence Male	Female	Total	Sample Size M/F	Criteria	Setting
1	Andhra pradesh	-	*2002	27	2	24	3307	-	Political party workers
2	Chandigarh	U	1996-97	24.6	-	-	1182	-	CB
3	Delhi	R	1984-87	79.9	29	-	3375	-	CB
4	Delhi	U	1991-94	28.1	2.3	-	1393/1464	Current smokers	CB
5	Haryana	R	1991-94	48.5	20.6	-	548/637	Current smokers	CB
6	Kerala	R	1999-00	83	7	-	151/89	current and past	CB
7	Kerala	U	1999-00	62	1	-	96/144	current and past	CB
8	Maharashtra	U	1999-00	38	2	-	107/136	current and past	CB
9	Punjab, Ludhiana	R	*1994	-	-	8.9	623/477	-	CB
10	Rajasthan	R	*1994	-	-	42.4	805/345	-	CB
11	Rajasthan	U	2002-03	26.1	1.7	13.7	226/232	current and past	CB
12	Tamil Nadu	U	1999-00	-	-	18.4	221	-	LIG

Prevalence of Smoking (%)Indian Population (Industrial Population)							
				Prevalence		Sample- Size	
S.No.	Place	Type	Year	Male	Female	M/F	Criteria
1	Assam	R	2001-03	9.9	0.2	1200/1224	any form
2	Bangalore	U	2001-03	23.1	0.1	2528/1260	any form
3	Coimbatore	U	2001-03	26.7	0.1	1741/1346	any form
4	Delhi	U	2001-03	24.7	0.7	2354/1043	any form
5	Hyderabad	U	2001-03	15.8	-	2765	any form
6	Ludhiana	Semi U	2001-03	21.4	-	2000	any form
7	Nagpur	Semi U	2001-03	17.20	0.05	2971/1832	any form
8	Pune	Semi U	2001-03	13.1	0	1891/1735	any form
9	Trivandrum	U	2001-03	27.6	0.2	1561/905	any form
10	Lucknow	U	2001-03	16.8	0.2	2806	any form


Prevelance of Smoking in Males and Female in Different States of India
Prevelance (%)
30
25
20
15
10
5
0
Assam
Bangalore
Coimbatore
Delhi
Hyderabad
Ludhiana
Nagpur
Pune
Trivandrum
Lucknow
Male
Female


Prevelance (%) of Smoking Indian Population
INDIA
Ludhiana
I 21.4
Chandigarh
U 24.6
Haryana
R 48.5 20.6
Delhi
R 79.8 29.0
U 28.1 2.3
I 24.7 0.7
Rajasthan
U 26.1 1.7
Lucknow
I 16.8 0.2
Assam
I 9.9 0.2
Nagpur
I 17.20 0.05
Maharashtra
U 38.0 2.0
Pune
I 13.1 0
Andhra Pradesh
? 27.0 2.0
Hyderabad
I 15.8
Bangalore
I 23.1 9.1
Coimbatore
I 26.7 0.1
Kerala
R 83.0 7.0
U 62.0 1.0
I 27.6 0.2
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
U - Urban
R - Rural
I - Industrial
Male
Female
? Unknown

3.5 Anthropometric indicators:

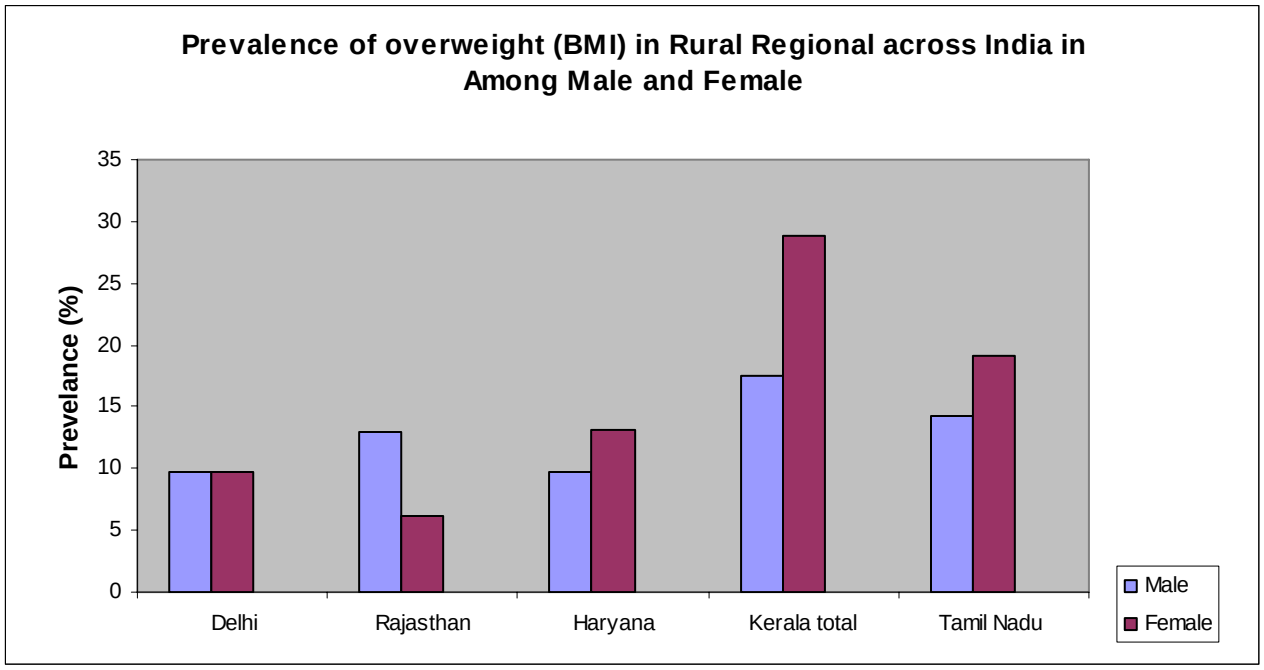
The seminal studies of McKeigue and Hughes in the late 1980s implicated insulin resistance and low HDL-cholesterol as the major driving force of CVD in India (26, 27, 45, 46). Waist-hip ratio as a surrogate marker of abdominal obesity and higher BMI was considered to be a marker of insulin resistance (26). This generated considerable interest in obtaining the prevalence of these risk determinants amongst Indians. Further the adverse consequences of abnormal BMI was believed to be higher among Indians as for any given BMI, Indians have a higher percentage of body fat as compared to the western population. This has led to the recommendation of lower cut offs of BMI for Asians in general and South Asians in particular.

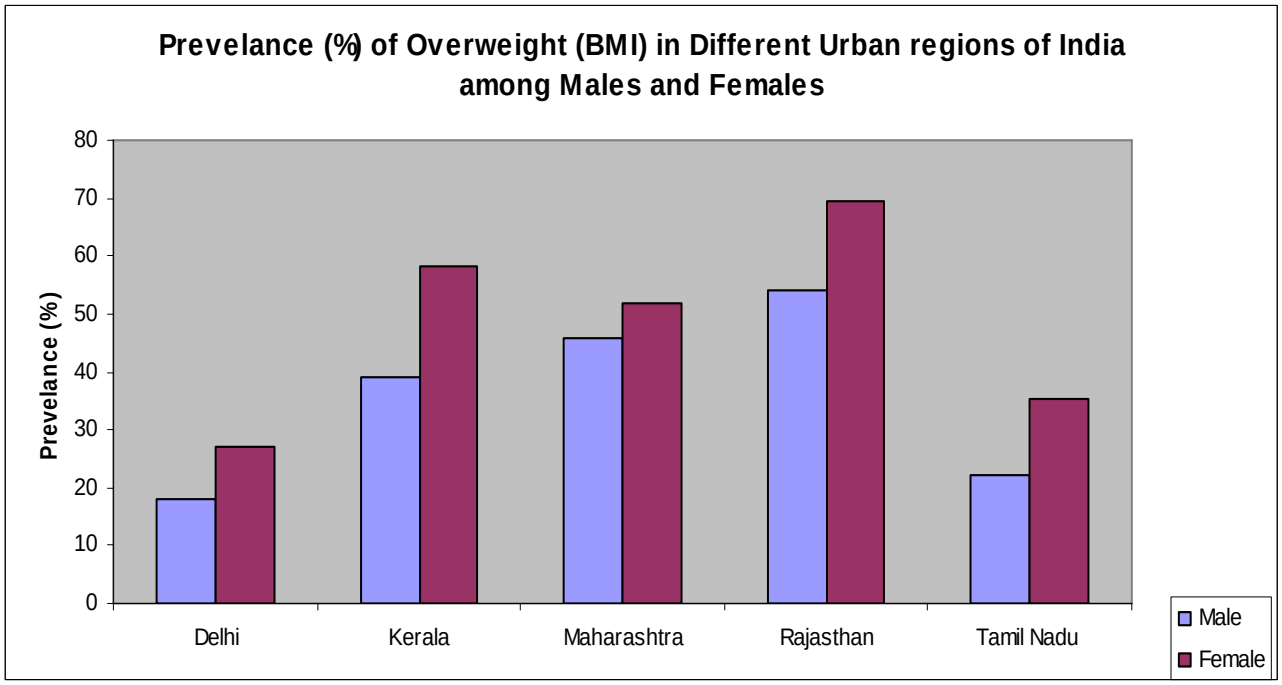
We reviewed systematically the published studies of BMI, waist circumference, waist hip ratio and physical activity levels in Indians. These are appended as Appendices VI-VIII. Our review suggests that there is a rising trend in the overall prevalence of overweight and obesity with an urban-rural gradient in the prevalence, with urban residents having a higher two to three fold prevalence as compared to rural residents. The prevalence of obesity (BMI$\geq$30) is usually lower compared to the western population. The overweight category comprises of almost a third to half the population in every survey. Women are equally affected. Abdominal obesity, using both waist circumference and waist hip ratio, too is more common among urban residents as compared to rural residents. The urban-rural gradient is particularly evident when waist circumference is used as a measure of abdominal obesity instead of waist circumference. Few studies have studied physical activity level, mainly in the upper and middle income groups and have found that leisure time physical activity to be generally lower among these groups.

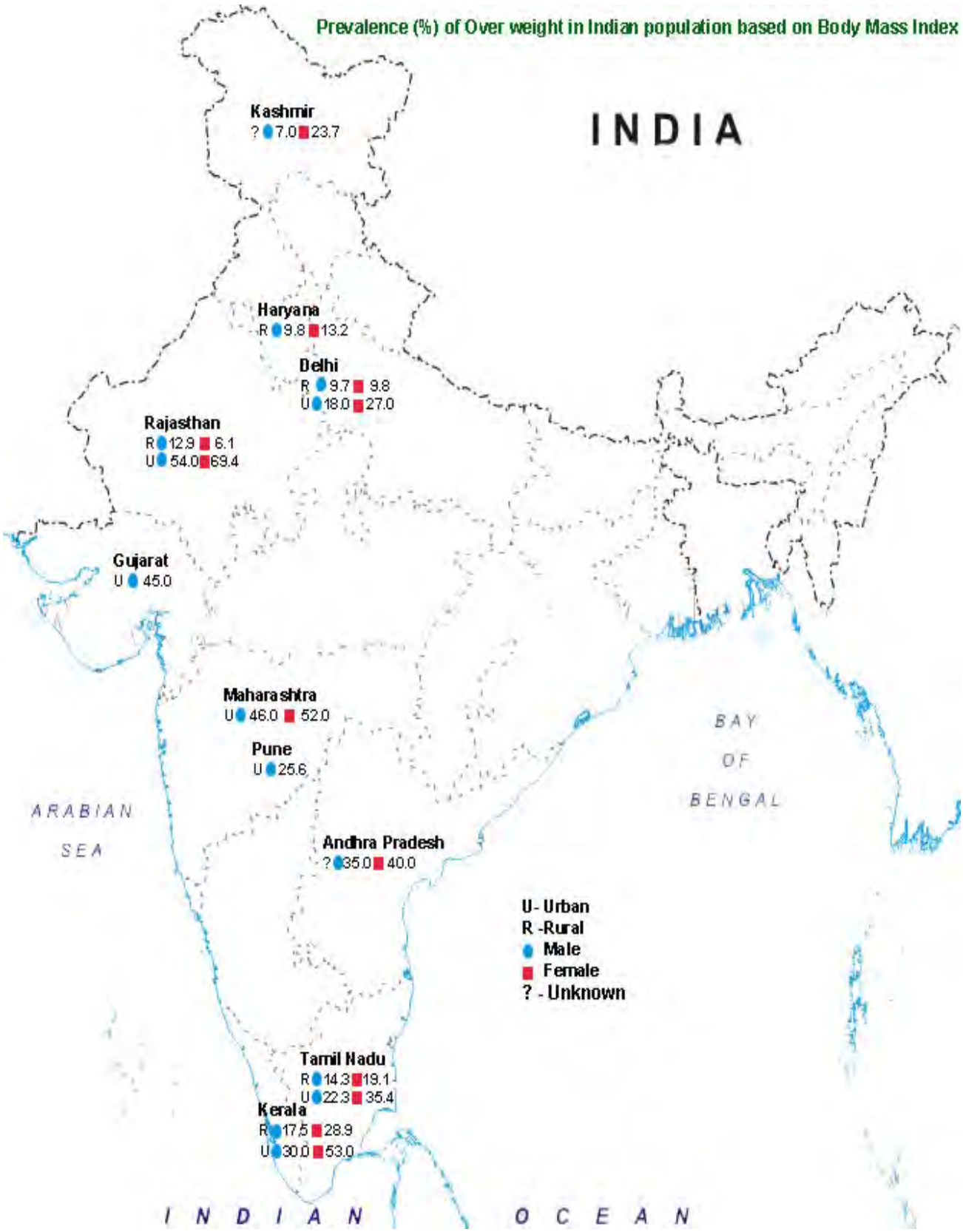
The current studies highlighting the prevalence for various anthropometric variables in India have been captured in table for Prevalence of Overweight based on BMI ,Abdominal Obesity, Waist Hip Ratio(refer file Table and graphs.xls). The tables display study location, type of study (urban/ rural) respective age- group and gender, criteria for diagnosis, study setting and the references. An attempt has been made to present the data in graphical form, however, the marked heterogeneity among studies due to varying time periods of data collection as well as differing definitions for defining the different anthropometric variables should not be discounted. (For complete details on inclusion criteria please refer Appendix III, references – refer.xls).

Prevalence of Overweight in Indian Population Based on BMI (Cross- sectional studies)												
S.No.	**Place**	**Type**	**Yr. of Study**	**Age Gp.**	**Criteria**	**Prevalence (%)**			**Sample Size (N)**			**Setting**
						Male	**Female**	**Total**	**Men**	**Women**	**Total**	
1	Andhra Pradesh	-	2002*	>20	>=27	35.0	40.0	36.0	1037	154	1191	Political party workers
2	Delhi	R	1987	25-64	>25	9.7	9.8	9.8	616	1116	1732	CB
3	Delhi	U	2003	14-18	>23	16.7	21.0	18.3	155	95	250	Post pubertal & young adults
4	Delhi	-	2000	18-69	>22	18.0	27.0	24.9	52	175	227	Urban slum
5	Ernakulam, Kerala	U	2003*	17-18	>23	-	24.0	-	-	200	-	College going girls
6	Gujrat, Surat	U	1994-95	20-59	>=25	45.0	-	-	950	-	950	IP
7	Haryana	R	1994	35-64	>25	9.8	13.2	11.6	542	630	1172	CB
8	Kashmir	-	2000*	>=40	-	7.0	23.7	15.0	2496	2587	5083	CB
9	Kerala	U	1998-99	30-64	>=25	39.2	58.2	48.7	-	-	518	CB
10	Kerala	R	1998-99	30-64	>=25	22.6	34.5	28.5	628	877	1505	CB
11	Maharashtra	U	2000	>=60	>22.25	46	52	49.36	107	136	243	CB
12	Pune	U	2004*	10-15	>25	25.6	-	-	1228	-	-	School based
13	Punjab	R	1994*	>30	M->27, F>25	-	-	16.6	623	477	1100	CB
14	Rajasthan	R	1997*	>=20	>=27	-	-	6.0	1982	1166	3148	CB
15	Rajasthan	U	2003	>=20	>=25	54.0	69.4	62.0	226	232	458	CB
16	Tamil Nadu	U	2000	>=20	>=25	22.3	35.4	29.8	708	960	1668	CB
17	Tamil Nadu	R	2003	>=20	>=25	14.3	19.1	17.1	-	-	1213	CB

U-Urban, R-Rural
CB-Community based
LIG-Low Income Group
IP - Industry Population
= - not reported
** denotes publication year*

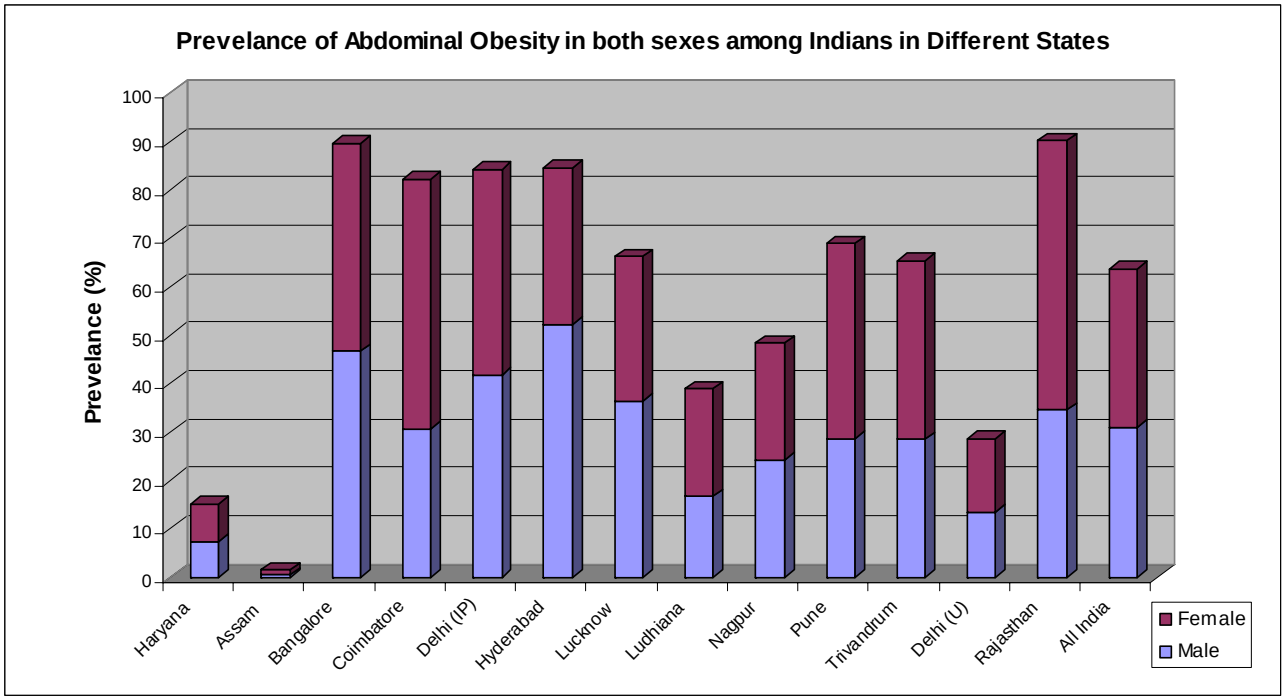

Prevalence of overweight (BMI) in Rural Regional across India in Among Male and Female
Prevelance (%)
35
30
25
20
15
10
5
0
Delhi
Rajasthan
Haryana
Kerala total
Tamil Nadu
Male
Female


Prevelance (%) of Overweight (BMI) in Different Urban regions of India among Males and Females
Prevelance (%)
80
70
60
50
40
30
20
10
0
Delhi
Kerala
Maharashtra
Rajasthan
Tamil Nadu
Male
Female


Prevalence (%) of Over weight in Indian population based on Body Mass Index
INDIA
Kashmir
? 7.0 23.7
Haryana
R 9.8 13.2
Delhi
R 9.7 9.8
U 18.0 27.0
Rajasthan
R 12.9 6.1
U 54.0 69.4
Gujarat
U 45.0
Maharashtra
U 46.0 52.0
Pune
U 25.6
Andhra Pradesh
? 35.0 40.0
Tamil Nadu
R 14.3 19.1
U 22.3 35.4
Kerala
R 17.5 28.9
U 30.0 53.0
U- Urban
R -Rural
Male
Female
? - Unknown
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN

Prevalence (%) of Abdominal Obesity among Indian population from Cross Sectional Studies (waist – circumference)												
S.No.	**Place of study**	**Type**	**Yr. of study**	**Age-Gp**	**Criteria (Waist circumference - cm)**	**Prevalence (%)**			**Sample Size (N)**			
						Male	**Female**	**Total**	**Male**	**Female**	**Total**	**Setting**
1	Haryana	R	1994	35-64	M->94, F->88	7.3	7.8	7.6	548	637	1185	CB
2	Chennai	U	1995	20-75	M->=90,F->=85	-	-	31.4	-	-	475	CB
4	Assam	IP	2001-03	20-69	M->90, F->85	0.4	1.1	0.7	1190	1213	2403	IP
5	Bangalore	IP	2001-03	20-69	M->90, F->85	46.6	43	44.9	906	790	1696	IP
6	Coimbatore	IP	2001-03	20-69	M->90, F->85	30.7	51.5	40.6	1100	989	2089	IP
7	Delhi	IP	2001-03	20-69	M->90, F->85	41.7	42.5	42	2354	1043	3397	IP
8	Hyderabad	IP	2001-03	20-69	M->90, F->85	52.2	32.4	45.9	882	407	1289	IP
9	Lucknow	IP	2001-03	20-69	M->90, F->85	36.3	29.9	33.5	944	755	1699	IP
10	Ludhiana	IP	2001-03	20-69	M->90, F->85	16.6	22.2	16.7	832	18	850	IP
11	Nagpur	IP	2001-03	20-69	M->90, F->85	24.2	24.1	24.2	1408	819	2227	IP
12	Pune	IP	2001-03	20-69	M->90, F->85	28.6	40.3	34.4	1164	1144	2308	IP
13	Trivandrum	IP	2001-03	20-69	M->90, F->85	28.4	36.9	32.2	1118	897	2015	IP
14	Delhi	U	2002	14-25	M>=79.1, F>=76.1	13.4	15.2	13.6	331	46	377	^
15	Rajasthan	-	2003	>=20	M- >102, F->88	34.5	55.6	45.2	226	232	458	CB
	All India	IP	2001-03	20-69	M->90, F->85	30.9	32.8	31.7	8075	11898	19973	IP

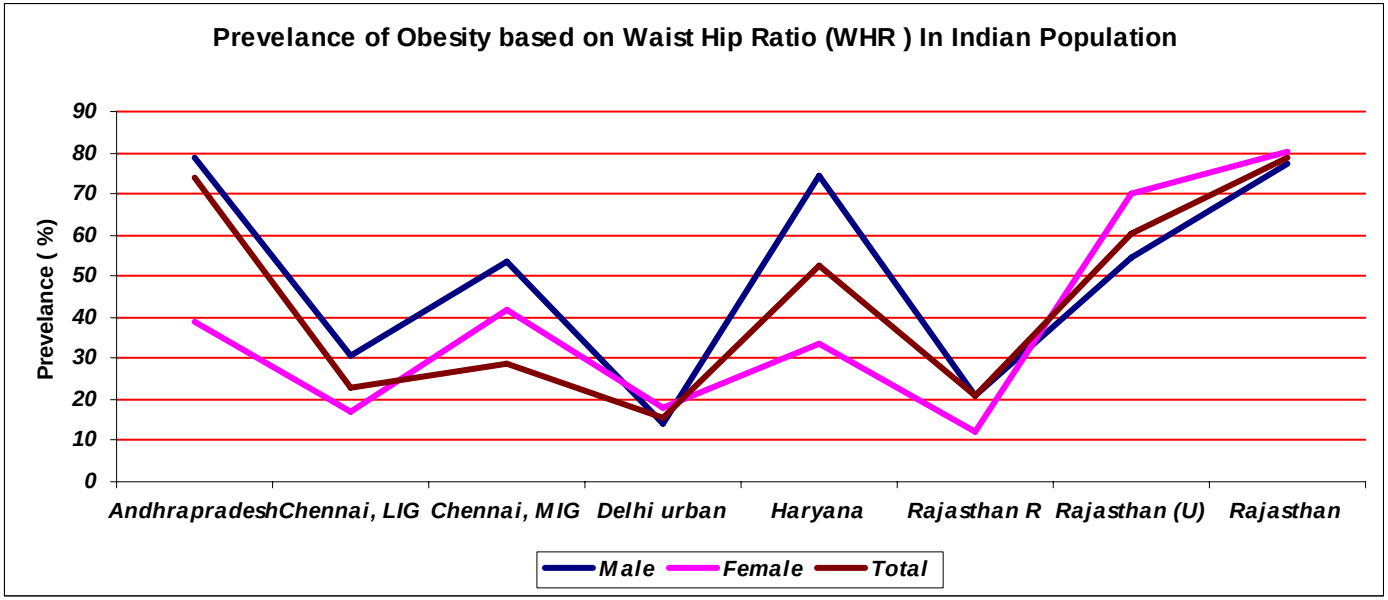
U-Urban, R-Rural
CB-Community based
LIG-Low Income Group
IP - Industry Population
= - not reported

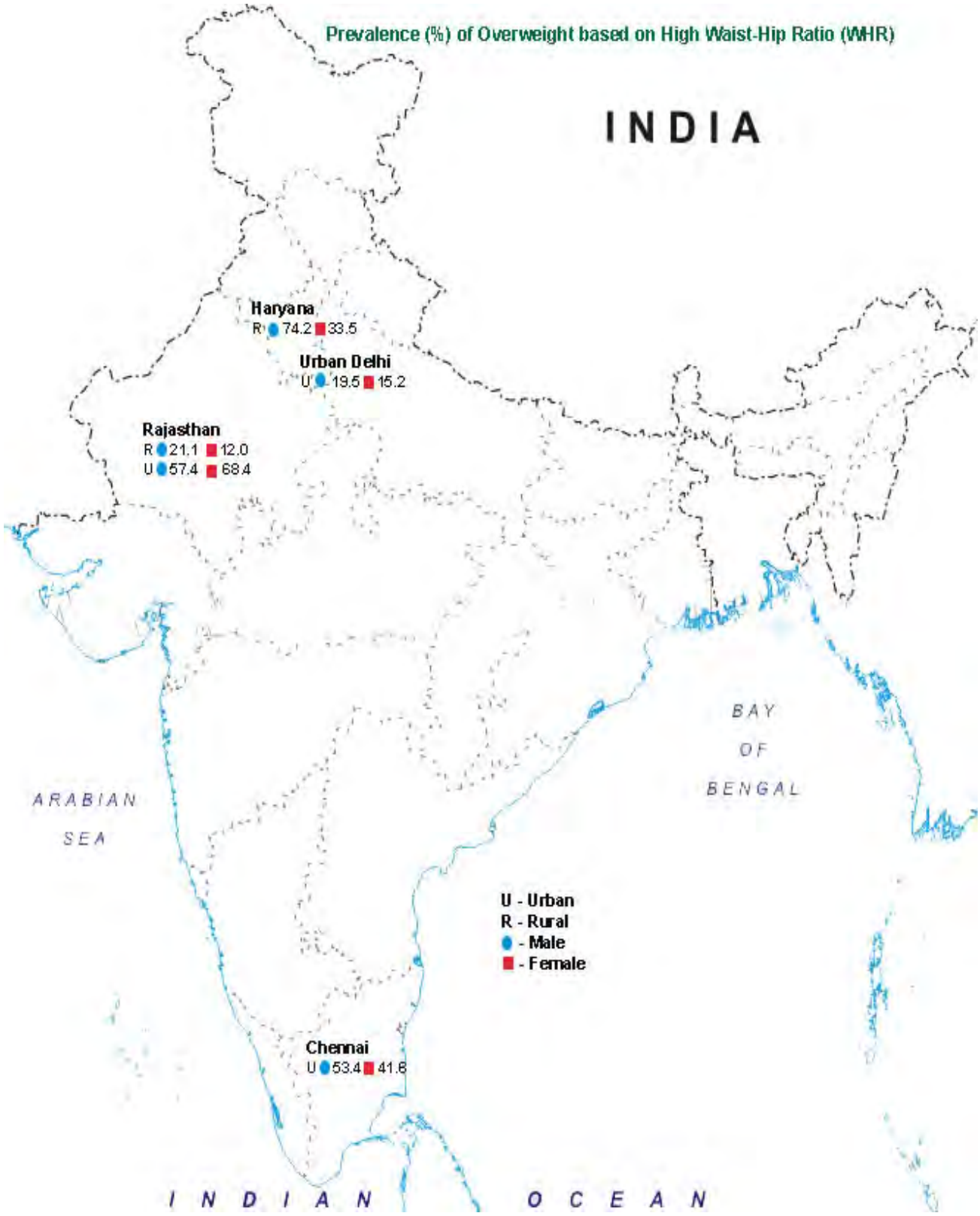

Prevelance of Abdominal Obesity in both sexes among Indians in Different States
Prevelance (%)
100
90
80
70
60
50
40
30
20
10
0
Haryana
Assam
Bangalore
Coimbatore
Delhi (IP)
Hyderabad
Lucknow
Ludhiana
Nagpur
Pune
Trivandrum
Delhi (U)
Rajasthan
All India
Female
Male


Prevalence (%) of Abdominal Obesity Among Indians
INDIA
Ludhiana
I 16.6 22.2
Haryana
R 7.3 7.8
Delhi
I 41.7 42.5
Lucknow
I 36.3 29.9
Assam
I 0.4 1.1
Rajasthan
U 34.5 55.6
Nagpur
I 24.2 24.1
Pune
I 28.6 40.3
BAY
OF
BENGAL
ARABIAN
SEA
Hyderabad
I 52.2 32.4
U - Urban
R - Rural
Male
Female
Bangalore
I 46.6 43.0
Coimbatore
I 30.7 51.5
Trivandrum
I 28.4 36.9
INDIAN OCEAN

Prevalence Overweight based on Waist Hip Ratio (WHR) in Indian Population (cross sectional studies)												
						Prevalence (%)			Sample Size (N))			
S.No.	**Location**	**Type of Study**	**Year**	**Criteria**	**Age-Gp**	**Male**	**Female**	**Total**	**Male**	**Female**	**Total**	**Setting**
1	Andhra Pradesh	NA	2002*	>0.9	>20	79	39.0	74.0	2329	79	2408	Political party Workers
2	Chennai	U	1997	M >0.9 F>0.85	>20	30.8	16.9	23.1	347	436	783	LIG
3	Chennai	U	1997	M >0.9 F>0.85	>20	53.4	41.6	28.5	209	269	478	MIG
4	Delhi urban	U	2003	M>-.86,F->.84	14-18	14.1	17.9	15.5	155	95	250	Post pubertal & young adults
5	Haryana	R	1994	M- >0.9, F->0.8	>35	74.2	33.5	52.4	547	633	1180	CB
6	Rajasthan	R	*1994	>0.93	>25	21.1	12.0	20.8	805	345	1150	CB
7	Rajasthan	U	1994	M- >0.9/ F- >0.8	>=20	54.7	68.4	60.2	1415	797	2212	CB
8	Rajasthan	NA	2003	M- >0.9, F->0.8	>=20	77.4	80.2	78.8	226	232	458	CB

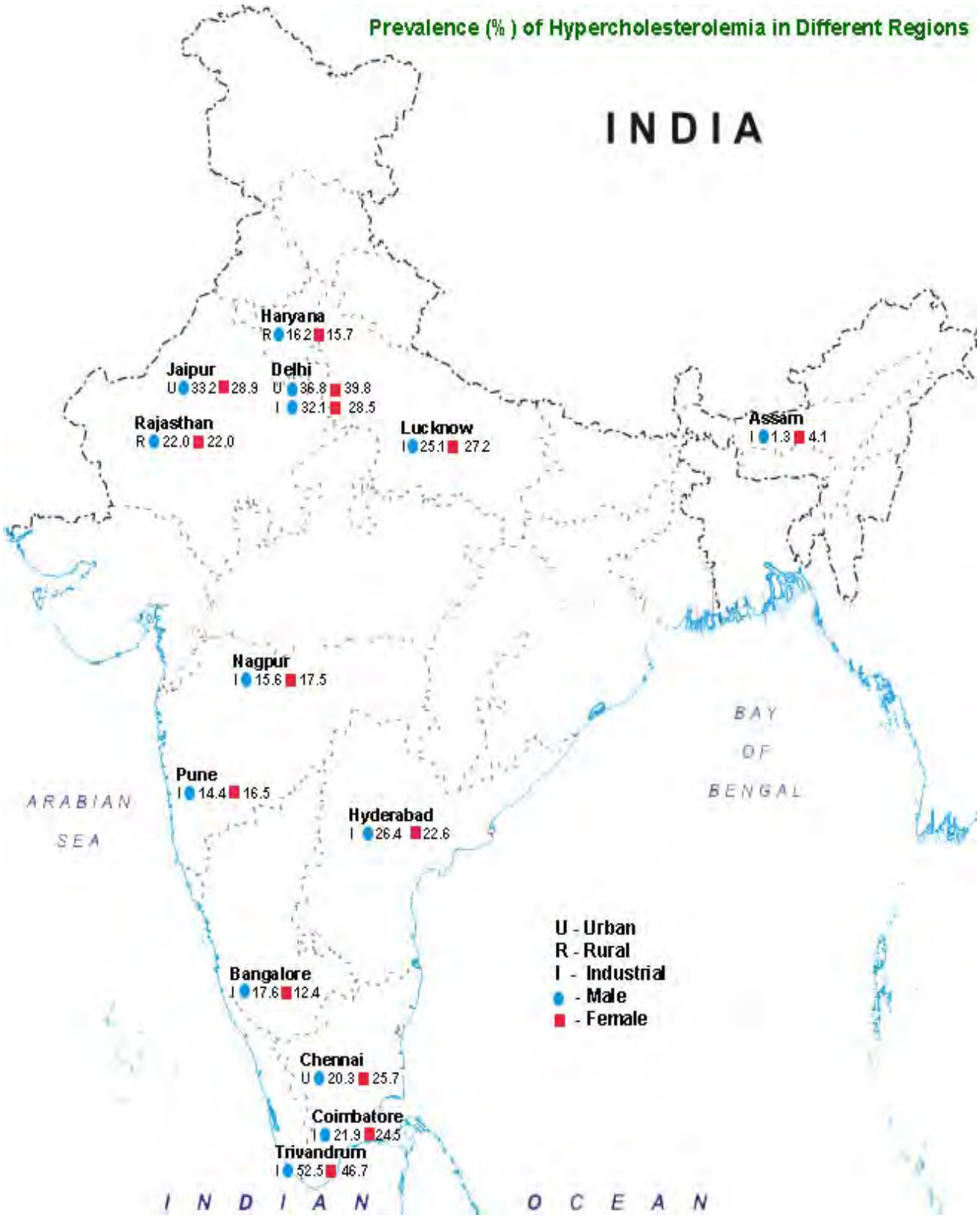
CB-Community based *U-Urban, R-Rural*
IP-Industrial population ** denotes publication year* ^ Young adults in schools & colleges




Prevalence (%) of Overweight based on High Waist-Hip Ratio (WHR)
INDIA
Haryana
R 74.2 33.5
Urban Delhi
U 19.5 15.2
Rajasthan
R 21.1 12.0
U 57.4 68.4
BAY
OF
BENGAL
ARABIAN
SEA
U - Urban
R - Rural
- Male
- Female
Chennai
U 53.4 41.8
INDIAN OCEAN

Prevalence of hypercholesterolemia(%) in Indian Population										
S.No.	**Place**	**Type**	**Year**	**Age-Gp.**	**Prevalence**			**Sample Size**	**Criteria**	**Setting**
					Male	Female	Total	M/F		
1	Delhi	R	1984-88	25-64	23.00	23.90	-	3375	>190mg%	CB
2	Delhi	U	1991-94	35-65	36.8	39.8	-	1393/1464	>=200mg%	CB
3	Haryana	R	1991-94	35-65	16.2	15.7	-	548/637	>=200mg%	CB
4	Rajasthan	R	1991-93	20-70	22	22	22	202/98	>200mg%	CB
5	Punjab, Ludhiana	R	*1994	30-70	-	-	7	623/477	>240mg%	CB
6	Chennai	U Slum	1996-1997	25-70	-	-	14.2	783	>5.2mmol/l	CB
7	Chennai	U Non-slum	1996-1997	25-70	-	-	24.2	479	>5.2mmol/l	CB
8	Chennai	U	1996-97	10-70	20.3	25.7	23.3	-	-	CB
9	Rajasthan	U	1997-98	13-17	-	-	6.8	89/148	>200mg%	adolescents of the middle- and upper-middle class
10	Kerala-Thiruvananthapuram	U	1999	35-44	-	-	32	206	>239 mg/dl	CB
11	Jaipur	U	2001	25-70	37.1	43.1	-	523/559	>=200mg%	CB
12	Andra Pradesh		*2002	25-70	32	22	31	3307	>200mg/dl	Political party workers
13	Jaipur	U	2002-03	25-70	33.2	28.9	-	226/232	>=200mg%	Punjabi Bhatia community

M- Men, F- Female, T- Total
U-Urban, R-Rural
* denotes publication year


Prevalence (%) of Hypercholesterolemia in Different Regions
INDIA
Haryana
R 16.2 15.7
Jaipur
U 33.2 28.9
Delhi
U 36.8 39.8
I 32.1 28.5
Rajasthan
R 22.0 22.0
Lucknow
I 25.1 27.2
Assam
I 1.3 4.1
Nagpur
I 15.6 17.5
Pune
I 14.4 16.5
Hyderabad
I 26.4 22.6
Bangalore
I 17.6 12.4
Chennai
U 20.3 25.7
Coimbatore
I 21.9 24.5
Trivandrum
I 52.5 46.7
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN
U - Urban
R - Rural
I - Industrial
- Male
- Female

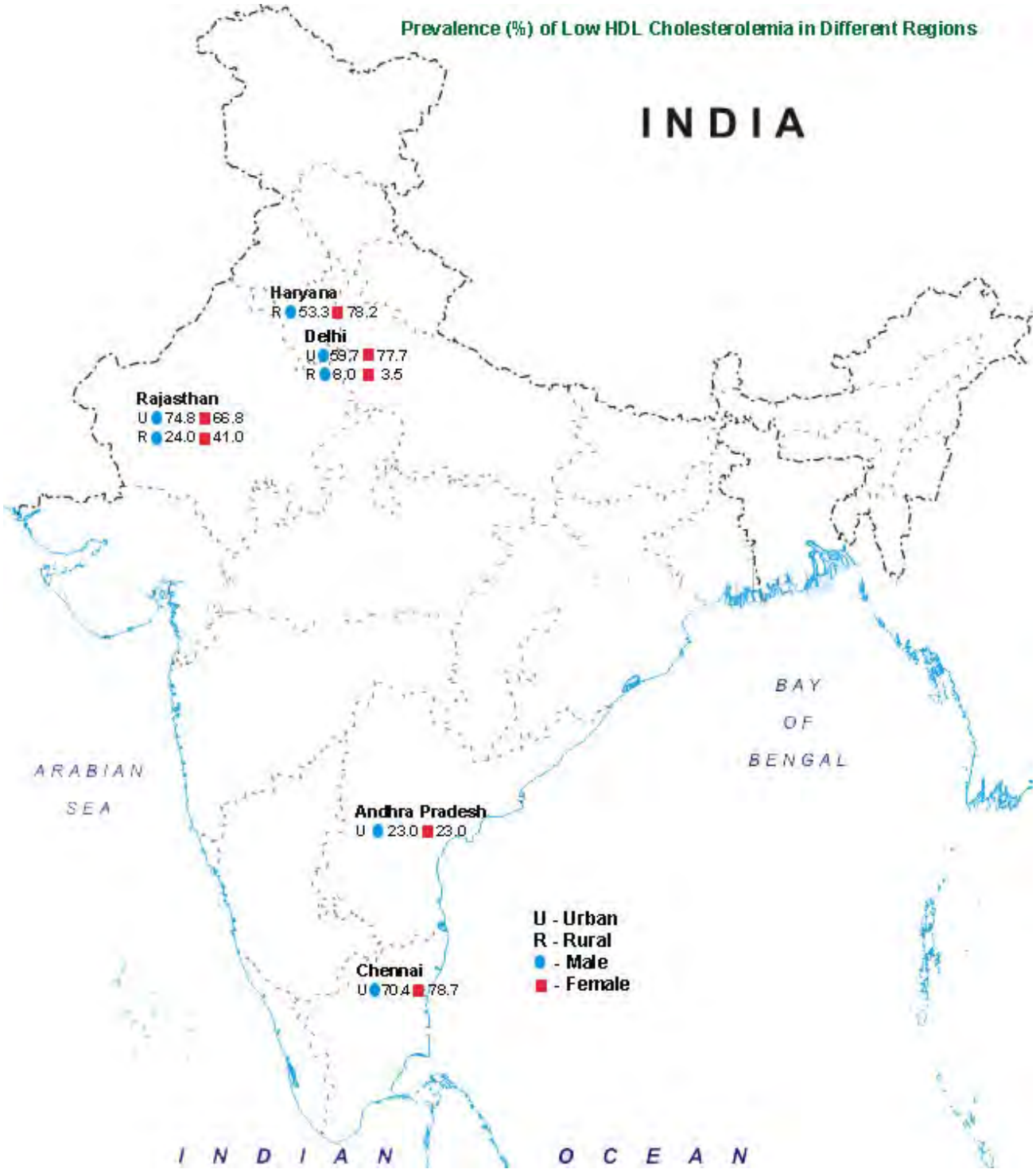
Prevalence Hyper LDL Cholesterolaemia (%) In Indian Population										
S.No.	Place	Type	Year	Age Gp	Prevalence			Sample size	Criteria	Setting
					Male	Female	Total			
1	Delhi	U	1984-87	25-64	49	46.8	-	13723	>110mg%	CB
2	Delhi	R	1984-87	25-64	29	27	-	3375	>110mg%	CB
3	Rajasthan	R	1991-93	20-73	18	28	-	202/98	>130mg/dl	CB
4	Andhra Pradesh	-	*2002	20-70	25	27	26	3307	>130mg%	political party Workers
5	Rajasthan	U	2002-03	20-70	38.1	34.9	-	226/232	>=130mg/dl	CB

U-Urban, R-Rural
** denotes publication year*
M- Men, F- Female, T- Total
CB-Community based

Prevalence (%) Low HDL Cholesterolemia In Indian Population									
					Prevalence		Sample size		
S No.	Place	Type	Year	Age Gp	Male	Female	Male /Female	Criteria	Setting
1	Andhra Pradesh	-	*2002	>=20	23	23	3307	<40mg%	Political party workers
2	Chennai	U	1996-97	>=20	70.4	78.7	-	**	CB
3	Delhi	R	1984-87	25-64	8	3.5	3375	<35mg/dl	CB
4	Delhi	U	1991-94	35-64	59.7	77.7	1393/1464	**	CB
5	Haryana	R	1991-94	35-64	53.3	78.2	548/637	**	CB
6	Rajasthan	R	1991-93	>=20	24	41	202/98	<35mg%	CB
7	Rajasthan	U	2002-03	20-70	74.8	-	226	**	CB

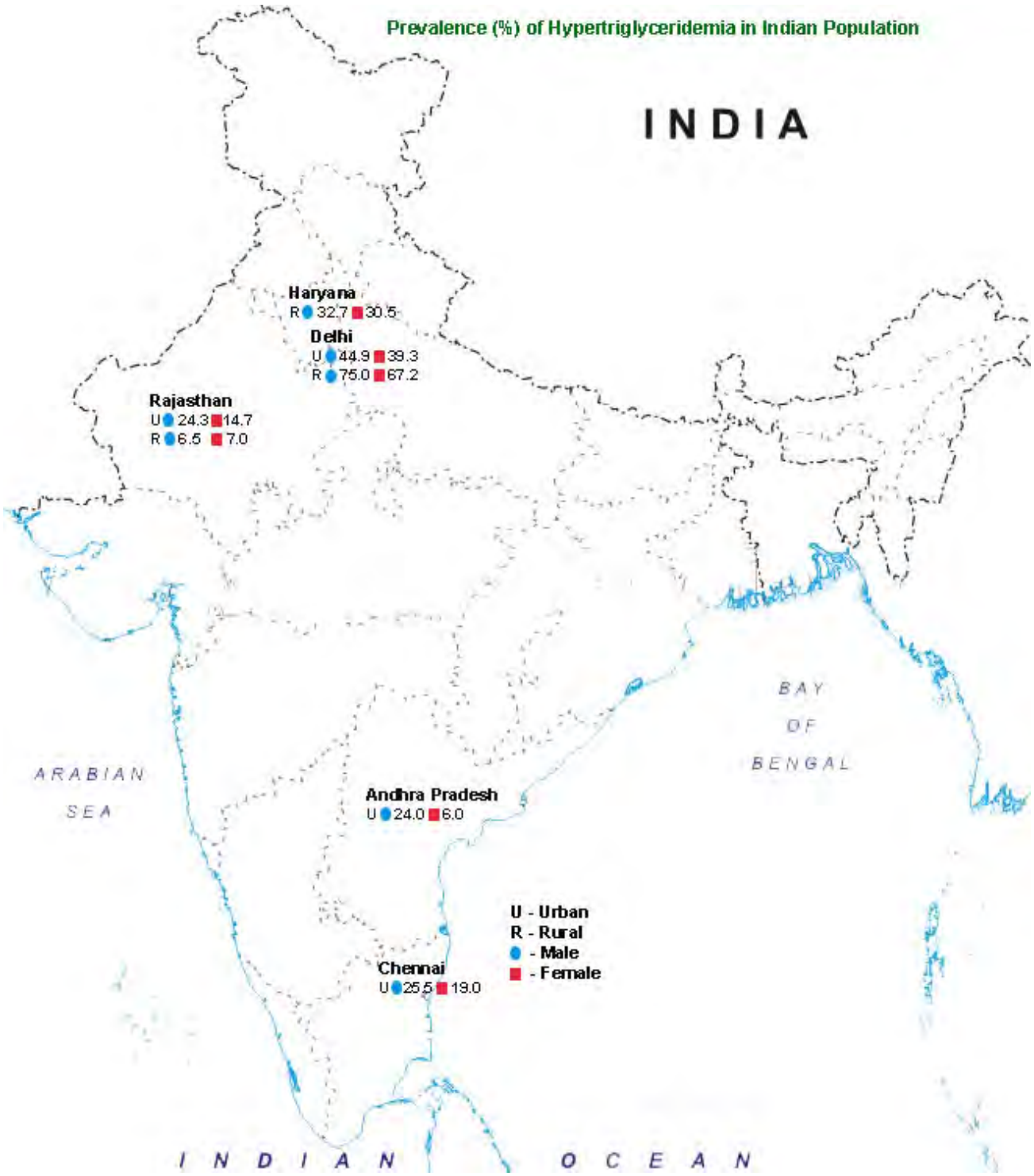
U-Urban, R-Rural
** denotes publication year*
M-Men, W/F-Women, T-Total
CB-Community based


Prevalence (%) of Hyper LDL Cholesterolaemia in Indian Population
INDIA
Delhi
U 49.0 46.8
R 29.0 27.0
Rajasthan
U 38.1 34.9
R 18.0 28.0
Andhra Pradesh
U 25.0 27.0
U - Urban
R - Rural
- Male
- Female
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN


Prevalence (%) of Low HDL Cholesterolemia in Different Regions
INDIA
Haryana
R 53.3 78.2
Delhi
U 59.7 77.7
R 8.0 3.5
Rajasthan
U 74.8 66.8
R 24.0 41.0
Andhra Pradesh
U 23.0 23.0
Chennai
U 70.4 78.7
U - Urban
R - Rural
- Male
- Female
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN

Prevalence (%) of Hypertriglyceridemia In Indian Population										
S.No.	**Place**	**Type**	**Year**	**Age-Gp**	**Prevalence**			**Sample size**	**Criteria**	**Setting**
					Male	**Female**	**Total**	**M/F**		
1	Andhra Pradesh	semiU	*2002	20-70	-	-	45.98	442/210	NA	CB
2	Andhra Pradesh	-	*2002	20-70+	41	15	38	3307	>150mg%	Political party workers
3	Andhra Pradesh	-	*2002	20-70+	24	6	23	3307	>200mg%	Political party workers
4	Chennai	U	1996-97	20-70+	25.5	19	-	-	-	CB
5	Delhi	R	1984-87	25-64	75	67.2	-	3375	>120	CB
6	Delhi	U	1991-94	35-64	44.9	39.3	-	1393/1464	>150mg%	CB
7	Haryana	R	1991-94	35-64	32.7	30.5	-	548/637	>150mg%	CB
8	Rajasthan	R	1994	>=20	6.5	7	6.7	202/98	>250mg%	CB
9	Rajasthan	U	2002-03	20-70	24.3	14.7	-	226/232	>150mg%	CB

U-Urban, R-Rural
** denotes publication year*
M - Men, F - Female, T - Total
- Unknown
CB-Community Based


Prevalence (%) of Hypertriglyceridemia in Indian Population
INDIA
Haryana
R 32.7 30.5
Delhi
U 44.9 39.3
R 75.0 67.2
Rajasthan
U 24.3 14.7
R 6.5 7.0
Andhra Pradesh
U 24.0 6.0
Chennai
U 25.5 19.0
U - Urban
R - Rural
- Male
- Female
ARABIAN SEA
BAY OF BENGAL
INDIAN OCEAN

4. Community based CVD prevention programs

Several community based intervention programs for the prevention of CVD were initiated in Europe and USA in the 1970s. However, attempts made to interpret or compare the findings are not adequate. Selected community based CVD prevention studies from developed and developing countries are summarized in table 10. These intervention studies have shown mixed results and demonstrated that for CVD prevention activities to achieve the greatest benefits, a paradigm shift is required from the treatment of risk factors in isolation to a comprehensive cardiovascular risk-management approach (49,50).

Most of these major large scale community based cardiovascular disease intervention projects used population approach or combination of high risk approach and population approach or in other words a "comprehensive community-based approach". Additionally, results from other community based CVD intervention programmes like the ATS-Sardegna Campaign, the Swedish programme for prevention of CVD, a decentralized, community-related approach to reduce cardiovascular disease risk factor levels in Germany, Together for Heart Health- Beirut, Lebanon and Bootheel Heart health Project also support the comprehensive community based approach (51-55).

Programmes in the developing countries

INTERHEALTH is an international collaborative project in which participating nations work towards prevention and control of common risk factors for a group of NCDs using strategies that emphasize community involvement, health promotion activities, behavioral interventions, and prevention and control activities implemented through existing primary health care systems and other community structures (63). The aim was to demonstate how an integrated programme could be implemented in populations in all regions of the world, at every stage of the demographic and epidemiological transition.

In the framework of the Interhealth programme, special activities were undertaken among school children in Chile, and the United Republic of Tanzania. Large-scale community programmes were launched in Mauritius and China. The Tianjin Project was launched in China as part of the Interhealth Programme in 1984 and aimed at reducing high sodium intake among the entire population, decreasing smoking especially among men, and providing hypertension care by reorganising the existing primary health care services. After seven years of the programme, the prevelance of hypertension and obesity decreased among people aged 45-64 years in both genders (64). However, smoking rates increased among men, especially those with higher education. Body mass index remained unchanged in both genders.

Changes in population cholesterol concentrations and other cardiovascular risk factor levels after five years of the non-communicable disease intervention programme in Mauritius showed significant reduction in population blood pressure and serum lipid concenterations, increased leisure exercise, and decreased smoking and alcohol consumption (12). This national healthy lifestyle intervention programme in Mauritius through extensive use of the mass media, fiscal and legislative measures and community health promotion demonstrated that lifestyle intervention programmes can be implemented and can have positive impacts in developing countries.

5. Policies for Chronic Disease Control In India

5.1 Cardiovascular Diseases

There is no national cardiovascular control programme at the national level. There have been two major Working Groups for CVD prevention at the national level; the first in the year 1997 and the second in the year 2001-02. The Government of India carried out a pilot programme in 1998-99 with the All India Institute of Medical Sciences as the nodal agency.

This was a forerunner to the project "Sentinel Surveillance for Cardiovascular disease risk factors in industrialized populations" which was initiated in 2001, as a result of collaborative efforts between the Ministry of Health and the WHO. Ten industries across India were selected for studying cardiovascular risk factors and behavioral determinants in employees and their family members. The main objectives of this project are:

1) Evaluation and surveillance of CVD risk factors and its determinants;
2) To ascertain the incidence of CVD morbidity and mortality;
3) To impart health education for prevention of CVD and ascertain the changes in CVD risk profile through process indicators; and
4) To develop guidelines for detection and management of CVD using the results of the study.

The detailed methods and the protocol are available at http://www.cvdsurveillance.org/. The WHO STEPS surveillance programme is also being carried out by the ICMR in 5 centres across India. This programme focuses on NCD surveillance using the STEPS methodology.

5.2 Diabetes

Currently, there is no organized diabetes control programme at the national level. A pilot programme was carried out during the Seventh Five Year Plan (1985-90) in some districts of Tamil Nadu, Karnataka and Jammu & Kashmir. The main objectives of the programme were a) to identify

high risk subjects at an early stage and imparting appropriate health education; b) early diagnosis and management of cases; and c) prevention, arrest or slowing of acute metabolic as well as chronic cardiovascular and renal complications of the disease. This programme could not be expanded further due to insufficient funds.

The Government of India has proposed an integrated diabetes and cardiovascular disease control programme as political commitment is high towards control of these diseases.

5.3 Policies for Tobacco Control in India

The Government of India enacted the Cigarettes (Regulation of Production, Supply and Distribution) Act in 1975 which made it mandatory to display a health warning on all packages and advertisements of cigarettes. During the 1980s and 1990s, Central and State Governments imposed further restrictions on tobacco trade and efforts were initiated to bring forth a comprehensive legislation for tobacco control.

The Indian Parliament passed the 'Cigarettes and Other Tobacco Products (Prohibition of Advertisement and Regulation of Trade and Commerce, Production, Supply and Distribution) Bill, 2003 in April 2003. This became an Act on May 18, 2003. This Act encompasses all forms of tobacco use and is enforceable across all states and union territories in India. This Act was followed by framing and notification of rules. Rules were formulated and enforced from May 1, 2004. The provisions included are:

- Prohibition of smoking in a public place
- Prohibition of advertisement of cigarettes and other tobacco products, and
- Prohibition of sale to minors

Health and agriculture are state subjects and the implementation of these laws is contingent upon the motivation and commitment of the states.

Table 11: Key provisions and penalties of the Cigarettes and Other Tobacco Products Act, 2003

Provisions	Penalties

Prohibition on direct and indirect advertisements of tobacco products, with the exception of advertising at the points of sale and on tobacco packs. The rules under the law restrict point-of-sale advertising in terms of size, inclusion of a mandatory warning and disallowing the use of any pictures or messages other than the name and picture of the product itself.	Advertisement is to be forfeited and disposed of. The first conviction is punishable with imprisonment of up to 2 years or a fine of up to Rs 1000, or both. Subsequent convictions are punishable with imprisonment of up to 5 years and a fine of up to Rs 5000.
Ban on gifts, prizes, scholarships or sponsorship of sports or other cultural events using the trademark or brand names of tobacco products.	
Prohibition of smoking in public places	Offences would be made compoundable; fine of up to Rs 200.
Prohibition on the sale of tobacco products to persons below the age of 18 years.	Offences would be compoundable with summary trials and fine of up to Rs 200.
Prohibition on the sale of tobacco within a radius of 100 yards of educational institutions.	
Legible and conspicuous display of health warnings including pictorial warnings (skull and cross bones and others as may be prescribed) on not less than one of the largest panels of the tobacco package with the text of the warning appearing in the same language(s) as the language(s) used on it.	Imprisonment of up to 2 years or a fine of up to Rs 5000, or both, for first conviction of a producer or manufacturer; subsequent convictions attract imprisonment of up to 5 years and with a fine of up to Rs 10,000; imprisonment of up to 1 year or a fine of up to Rs 1000, or both, for the first conviction of a seller or distributor; imprisonment of up to 2 years and a fine of up to Rs 3000 for subsequent convictions.
Indication of the tar and nicotine contents of the tobacco products on the package along with the maximum permissible limits as prescribed by the rules under this Act.	

National Tobacco Control Cell

This was set up as a result of collaborative efforts by the Ministry of Health and the WHO in February 2001 to provide impetus to tobacco control efforts and to coordinate these activities at the national level. It was also at the forefront of planning an anti-tobacco media campaign for the masses.

Tobacco cessation clinics

Thirteen tobacco cessation clinics were initiated on a pilot basis in 2002, as a collaborative effort between the Ministry of Health and the World Health organization. They were found to be feasible in Indian settings and the overall quit rates at 6 weeks was 16%.

Appendix I

A cross-sectional survey was carried out in the selected area in urban Delhi by cluster randomized sampling, stratified by geographical zone and type of colony. This study was part of an Indian Council of Medical Research Task Force Study conducted in 3050 individuals aged 35-64 years. The study was carried out from 1990-1994. The individuals underwent questionnaire administration, clinical and biochemical measurements to study the prevalence of cardiovascular risk factors (Table 1) and coronary heart disease. The age adjusted prevalence of CHD based on history and positive ECG changes was 103.2 in males and 100.2 in females.

Table 1: Prevalence of cardiovascular risk factors in study subjects (16)

	Males (%) (n=1456)	**Females (%) (n=1594)**	**Total (%) (n=3050)**
Smoking	28.7	2.6	15.1
Body Mass Index $\geq$25kg/m^2	35.5	48.6	24.4
Hypertension	25.5	29.0	27.3
Diabetes mellitus	10.9	11.2	11.1
Total Cholesterol $\geq$ 200 mg/dl	36.8	39.7	38.3
HDL Cholesterol $\leq$ 40 mg/dl	38.7	59.9	49.8
TC : HDL cholesterol ratio > 5	46.2	31.9	35.5
Triglyceride $\geq$150 mg/dl	45.2	39.7	42.6
Metabolic Syndrome (as per NCEP ATP III criteria)	26.8	33.4	30.8

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Appendix II

Capacity Assessment to Capacity Building

A detailed study of the capacity for prevention and control of CVD and Diabetes was conducted in 2002-2003, in India (Delhi, Thiruvananthapuram), Cameroon and Thailand by the Initiative for Cardiovascular Health Research in the Developing Countries (IC Health), which is a partnership programme initiated by WHO in 1999. This study utilized both qualitative and quantitative methods to evaluate the current capacity, in terms of health policies, programmes and infrastructure from the perspectives of the communities, patients, different categories of health care providers and policymakers. While recognition of CVD as a major public health problem was widely shared, knowledge of risk factors and their relation to CVD was inadequate among many community groups. Diabetes, smoking and physical inactivity were not among the well recognized causes of CVD, especially in the lower socio-economic groups. Primary care physicians felt very ill equipped (in knowledge, skills and infrastructure) to deal with CVD, including acute emergencies. Inexpensive but life saving drugs like aspirin were underutilized in the management of acute coronary events. Rural communities had very limited access to facilities for CVD prevention and care and referral linkages were poor, while urban communities felt that widely variable quality of care and high costs were barriers to treatment. Multi-purpose health workers and nurses saw high potential for their role in CVD prevention but said that they were limited by lack of appropriate training. Provincial policymakers, who were closer to the communities, were convinced that CVD was a growing problem which required urgent measures for prevention and control while national policymakers were not yet ready to commit resources for this effort. Clearly, capacity building is urgently needed to fill these multiple gaps so that the epidemic of CVD does not overwhelm countries which are unprepared to prevent it.

(Report under publication: for methodology and results of the study see www.ichealth.org)

Appendix III

A robust criteria was developed to include the studies cited for developing the CVD profile for different regions in the India.. This was done to maintain high quality of the information being provided through this process. After conducting a search of major databases using search words as outlined in the report, the studies were identified and further scrutinized for inclusion.

The inclusion criteria utilized were:

- Sample size $\geq$ 150.
- Sampling technique clearly outlined along with a clear description of study objectives.
- Standard definition utilization for diagnosis of hypertension/ diabetes/ other condition utilized in the study.
- Standard measurement protocols followed for measuring blood pressure and anthropometric indices such as height/ weight, waist circumference.
- For multiple publications from a single study, we chose the study with the highest sample size or if any special issue has been dealt with.

Studies describing the sampling technique, utilizing standardized measurement methods and definitions for diagnosis of hypertension/ diabetes/other conditions were considered to be strong and the remaining were classified as weak in terms of quality. Studies classified as strong were included in the review. (If the study period is not mentioned in the article then the publication date was recorded for quoting the study.)

Appendix IV: Review of Hypertension Prevalence in India

Methodology of Search

We searched the MEDLINE, EMBASE and INDMED databases from 1950-2004, to obtain prevalence studies of Hypertension. The search terms used were “prevalence”, “hypertension”, “high blood pressure”, “coronary risk factors” and “India”.

Characteristics of identified articles

Using the above literature search techniques, we identified thirty-four epidemiological studies published between 1954 and 2004. These studies were scrutinized for inclusion utilizing the criteria mentioned above. Studies classified as having strong quality have been included in this review.

All the studies identified were cross sectional in nature. Appendix IVa shows the study location (urban vs. rural), age group studied, sample size, criteria for diagnosis of hypertension, prevalence of hypertension in the total group, men and women separately.

There was marked heterogeneity among studies mostly due to the varying time periods of data collection and differing definitions of hypertension. However, prevalence of hypertension based on JNC criteria was available from 22 studies across India.

Prevalence of Hypertension

Dubey carried out one of the earliest study in India in 1954 and documented 4% prevalence of hypertension (criteria:>160/95) amongst industrial workers of Kanpur (71). In 1984, Wasir et al reported 3% prevalence of hypertension (criteria :$\geq$ 160/95) in Delhi (72). During 1984-87, Gopinath and Chadha reported the prevalence of hypertension in Delhi to be 11% among males and 12% among females in the urban areas and 4% and 3% respectively in rural areas (73,74). Another two studies carried out in rural areas of Haryana (1994-95) demonstrated 4.5% prevalence of hypertension (JNC V criteria) while urban areas of Chandigarh had a higher prevalence of 45% during 1996-97 (75, 76).

In 1994, we carried out a study involving more than 5000 individuals (3050 urban residents and 2487 rural residents) as part of the ICMR task force project which demonstrated 25% and 28% prevalence of hypertension among males and females respectively in urban Delhi and 13% and 11% in rural Haryana.

Further, Gupta through three epidemiological studies carried out in Jaipur during 1994, 2001 and 2003 demonstrated rising trend rates of 30%, 33%, and 51% respectively among males and 37%, 34% and 51% among females (7, 77).

From south India, Kutty carried out a study in rural Kerala during 1991 using the JNC criteria (>=140/90) and the prevalence was found to be 19% (78). Later studies in Kerala using JNC VI criteria, reported 37% prevalence of hypertension among 30-64 age group in 1998 and 55%

among 40-60 age group during 2000 (79, 80). A higher prevalence of 69% and 55% was recorded among elderly populations aged sixty and above in the urban and rural areas respectively during 2000 (81).

Few studies on prevalence on hypertension are available from eastern Indian population. In 2002, Hazarika et al reported 61% prevalence among men and women aged $\geq$ 30 years in Assam (82). They attributed this specifically to the high salt consumption among the tea garden workers.

The Sentinel Surveillance Project (Appendix XI) documented 28% overall prevalence of hypertension from 10 regions of the country using the criteria (SBP $\geq$ 140 and/or DBP $\geq$ 90 mm of Hg and/or a history of hypertension) in the age group 20-69 years. Another study carried out in 1998 among Industrial population in the Bharat Electronics Limited (BEL), India illustrated a prevalence of 30% among males (24).

Few studies have been carried out comparing different socio-economic groups. The initial study from urban Chennai by Mohan et al in 1996-97 reported 8.4% prevalence of hypertension among men and women aged 20 years and above and belonging to the low socio economic group (based on household income, occupation and dietary pattern) (9). The middle socio economic group had a higher prevalence (15%). A study conducted in the urban areas of Chennai during 2000 (age group>=40) reported a higher prevalence of hypertension (54%) among low income group (monthly income < Rs 30000/annum and 40% prevalence among high-income group (monthly income $\geq$ Rs 60000/annum) (83). Misra et al (8) reported 12% prevalence of hypertension in the slums of Delhi.

Appendix V: Review of Diabetes & Metabolic Syndrome in India

Methodology of Search

Prevalence studies on Diabetes were identified as using the same methodology described previously. The search terms used were “prevalence”, “diabetes”, “coronary risk factors”, “glucose abnormalities”, “dysglycaemia”, “insulin and metabolic syndrome” and “India”.

Characteristics of identified articles

Using the above literature search techniques, we identified twenty one epidemiological studies published between 1979 and 2004. Inclusion criteria as enumerated above were utilized to check for quality of the chosen articles and included based on these criteria.

All the studies identified were cross sectional in nature. Appendix Va shows the study location (urban vs. rural), age group studied, sample size, criteria for diagnosis of diabetes, prevalence of diabetes in the total group, men and women separately. There was marked heterogeneity among studies mostly due to the varying time periods of data collection and differing definitions of diabetes.

Gopinath and Chadha et al reported the prevalence of diabetes (criteria: clinical history and documented evidence of medication) to be 1.6 % among males and 1.6% among females in the urban areas and 0.5% and 0% respectively in rural areas in Delhi during 1984-87 (73,74). In 1994, we carried out a study involving more than 5000 individuals (3050 urban residents and 2487 rural residents) as part of the ICMR task force project, which demonstrated 11% prevalence of Diabetes among males and females in urban Delhi and 3% in rural Haryana.

In 1994, Wander reported 5% prevalence of diabetes (criteria: random venous blood glucose >180mg/dl or history) among a rural population in Ludhiana, Punjab (84). Further, three epidemiological studies carried out in Jaipur during 1994, 2001 and 2003 demonstrated rising trend rates of 1%, 8%, and 18% respectively among males and 1%, 7% and 14% respectively among females (7,77).

Similar trends have been observed in other parts of the country. The earliest study from the south Indian population reported a prevalence of 8.3% during 1989 in urban Chennai (85). Subsequent studies from urban Chennai reported the prevalence of diabetes at 12% in the year 1995 and 14% during 2000 (2-h post glucose value >=200mg/dl) (86,87). Prevalence in the rural areas of Tamil Nadu rose sharply from 2% in 1989 to 6% in 2003 (criteria: 2-h post glucose>=11.1 mmol/l) (88).

Kutty (89) carried out a study in Kerala during 1998-99 using the WHO criteria and the prevalence of Diabetes was found to be 5.9%. During the same period, Joseph et al reported 16% prevalence in the urban areas of Trivandrum in Kerala (90).

In 2000, a multi centric study involving six urban cities (Chennai, Bangalore, Hyderabad, Mumbai, Calcutta and New Delhi) in the country among the age group of 20-40 and >=40 age group showed a prevalence of 12.5% and 11.9% respectively (sample size: 5288 men; 5928 women) (91).

Few studies are available which have obtained data using standardized and similar methods. The Sentinel Surveillance Project, documented 10% overall prevalence of Diabetes from 10 regions of the country using the criteria (FPG $\geq$ 126 mg/dl or h/o diabetes) in the age group 20-69 years. The centre-wise prevalence data on Diabetes and metabolic syndrome using ATP III guidelines are provided in the Appendix Va & Vb.

Few studies have compared the prevalence in different socio economic groups. The initial study in urban Chennai by Mohan et al reported 6.5% prevalence of diabetes among men and women aged 20 years and above and belonging to the low socio economic group (based on household income, occupation and dietary pattern) (9). As compared to the middle socio economic group which had a higher prevalence (12.4%). A study conducted subsequently in the urban areas of Chennai during 2000 (age group>=40) reported a higher prevalence of diabetes (12.6%) among low income group and 25.5% prevalence among high-income group (83). Misra et al reported 10% prevalence of Diabetes in the slums of Delhi (8).

Metabolic syndrome

Studies on metabolic syndrome in India have used ATP III criteria as their definition. The details of the studies are given in Appendix Vb. The ICMR task force study reports a prevalence of Metabolic Syndrome in the urban areas of Delhi and rural Haryana to be 30% and 11% respectively. Later, Ramachandran et al showed a higher prevalence of metabolic syndrome (41%) during 1995 and Deepa et al reported a prevalence of 11.2% in urban Chennai during 1996-97 using WHO definition (34, 92).

Recently, Gupta et al reported 25% prevalence in Jaipur (93). Misra et al reported a 30% prevalence of metabolic syndrome among the urban slum population in Delhi, (8).The Sentinel surveillance project on Indian Industrial population reports an overall prevalence of 20% among industrial workers. Centre-wise prevalence is available in the Appendix-Vb.

Appendix VI: Systematic review of BMI

Methodology of Search

We searched the MEDLINE, EMBASE and INDMED databases from 1990-2004, to obtain prevalence studies of overweight & obesity. The search terms used were “prevalence”, “overweight”, “obesity”, “body mass index”, “hypertension”, “high blood pressure”, “glucose abnormalities”, “dysglycaemia”, “coronary”, “diabetes” “insulin and metabolic syndrome” and “India”. This was supplemented by examining the reference lists of each of the articles identified (both primary and review articles), manual retrieval, consulting with experts in the subjects, and checking citations.

Characteristics of identified articles

Using the above search techniques, we identified thirty-two epidemiological studies published between 1992 and 2004. To qualify for inclusion, we used the criteria mentioned above to judge the studies identified.

All the studies identified were cross sectional in nature. Of the thirty-two studies eleven studies addressed special issues like obesity among adolescents (five studies), urban-rural differences (three studies), socio economic differences (three studies) and slum vs. non-slum differences (two studies). Three studies were multi centric in nature. Twenty-five studies described the sampling technique, methods of anthropometric measurements used, and definition for diagnosis of overweight/obesity and hence were considered strong and remaining studies were classified as weak studies.

Appendix VIa shows the study location (urban vs rural), age group studied, sample size, criteria for diagnosis of overweight/obesity, prevalence of overweight/obesity in the overall group, men and women separately.

Most studies mentioned the prevalence of overweight/obesity as ancillary information and hence age-wise distribution of prevalence was lacking. There were marked heterogeneity among studies mostly due to the varying time periods of data collection and differing definitions of obesity. However prevalence of overweight/obesity based on NHANES III criteria was available from 16 studies across India.

Prevalence of Overweight/Obesity

The earliest study was carried out by Gopinath and Chadha et al in Delhi during 1984-87 who reported the prevalence of overweight/obesity to be 27% in the urban areas and 10% in rural areas (73, 74). In 1994, the ICMR task force project carried out by us demonstrated 43% prevalence of overweight in urban Delhi and 12% in rural Haryana.

Two other studies from north India published in 1994 and 2000 showed a prevalence of 17% (Ludhiana) and 15 % (Kashmir), respectively (84, 94). Further, Gupta demonstrated rising trend rates of 20%, 36%, and 62% in three epidemiological studies carried out during 1994, 2001 and 2003 respectively (7,77).

Similar trends are observed in other parts of the country. The earliest study from the south Indian population reported a prevalence of 27% during 1989 in urban Chennai and 2% in rural Tamil Nadu (85). Subsequent studies from urban Chennai reported the prevalence of overweight/obesity at 23% in the year 1995 and 30% during 2000 (86, 87). Prevalence in the rural areas of Tamil Nadu rose sharply from 2% in 1989 to 17% in 2003 (88). Kutty carried out a study in rural Kerala during 1991 using the criteria (BMI>27) and the prevalence was found to be 5.8% (78). Later studies in Kerala reported 49% prevalence of overweight among 30-64 age group in 1998 and 41% among 40-60 age group during 2000 (79, 80). A higher prevalence of 54% (criteria: BMI>22.25) was recorded among elderly populations (age group >=60 years) during 2000 (81).

Overall prevalence of overweight/obesity in the Sentinel Surveillance Project from 10 centres of the country using the criteria (BMI>=25) in the age group 20-69 was 31%. Dibrugarh in Assam had the lowest prevalence (0.5%) while Hyderabad in Andhra Pradesh had the highest (50%). North Indian populations in Delhi, Lucknow in Uttar Pradesh and Ludhiana in Punjab had prevalence of 41%, 37% and 15% respectively. Central Indian populations in Nagpur and Pune in Maharashtra had prevalences of 20% and 36% each. South Indian populations from Bangalore in Karnataka, Trivandrum in Kerala and Coimbatore in Tamil Nadu had a prevalence of 47%, 38% and 27% respectively.

Another study carried out in 1998 among Industrial population in the Bharat Electronics Limited (BEL), India illustrated a prevalence of 35% among males (24). The repeat survey suggests that the prevalence of overweight has risen from 35% to 41% over a period of five years in BEL.

The urban cities in the country are facing high prevalence of obesity. In 2000, a multi centric study involving six urban cities (Chennai, Bangalore, Hyderabad, Mumbai, Calcutta and New Delhi) in the country among the age group of 20-40 and >=40 age group showed a prevalence of 31% and 38% respectively (sample size: 5288 men; 5928 women) (91). Similarly, Shukla et al conducted a large study in Mumbai, Maharastra during 1994 had reported a prevalence of 26% among > 35 years age group (95).

Few studies were carried out comparing different socio economic groups. In urban Chennai, Mohan et al reported 20% prevalence of overweight/obesity among men and women aged 20 years and above and belonging to the low socio economic group (9). Similarly, the middle socio economic group had a higher prevalence (35%) during 1996-97. A study conducted during the urban areas of

Chennai during 2000 (age group>=40) reported a higher prevalence of 33% among low income group and 44% prevalence among high-income group (83).

Some studies addressed the gradients of obesity among slum /non-slum groups. The ICMR Task force study among dwellers of urban slum in Delhi showed a prevalence of 20%, as compared to urban and rural prevalence of 48% and 12% respectively. Misra et al reported 25% prevalence of obesity in the slums of Delhi (8).

Prevalence of overweight/obesity among adolescents and young adults has been reported from Delhi, Pune, Kerala and Tamil Nadu. Prevalence was higher among adolescents from Tamil Nadu (BMI>=25) even though the studies from Delhi study used a lower criteria (BMI>=23). Prevalence in Delhi was 18 % while in Tamil Nadu it was 20% (96,97) . Khadilkar et al reported a prevalence of 26% (BMI>25) among affluent school boys aged between ten and fifteen in Pune while Augustine et al reported 24% prevalence of overweight/obesity (BMI>23) among urban college going girls aged between seventeen and eighteen in Ernakulam Kerala (98,99).

Appendix VII: Systematic review of Waist circumference

Methodology of Search:

Prevalence studies on Abdominal Obesity were identified using the same methodology described previously. The search terms used were “prevalence”, “overweight”, “obesity”, “waist circumference”, “coronary”, “hypertension”, “high blood pressure”, “glucose abnormalities”, “dysglycaemia”, “diabetes”, “insulin and metabolic syndrome” and “India”.

Characteristics of identified articles

Using the above literature search techniques, we identified seven epidemiological studies published between 1994 and 2004. All the studies identified were cross sectional in nature. Of the seven studies, two were multi-centric, two studies address the issue of obesity among adolescents, one study compared slum vs. non-slum differences and two studies were conducted among industrial population.

Appendix VIIa shows the study location (urban vs rural), age group studied, sample size, criteria for diagnosis of abdominal obesity, prevalence of abdominal obesity in the total group, men and women separately.

Prevalence

Similar to data on BMI, most studies provided the prevalence of abdominal obesity as ancillary information and hence age-wise distribution of prevalence was lacking. There were marked heterogeneity among studies mostly due to the varying time periods of data collection and differing definitions of abdominal obesity. Prevalence of abdominal obesity based on Adult Treatment Protocol III was available with three studies and two studies used the modified ATP III recommendations for Indian population as their criteria. Remaining studies greatly varied in their definition for abdominal obesity.

Studies were mostly carried out among north Indian populations. Gupta et al reported a prevalence of abdominal obesity in Rajasthan from 33.2% in 2001 to 45% in 2003 among adults using the ATP III criteria (WC: Males->102cm, Females->88 cm) (7,77). ICMR Task force Project study (1994) reported a higher prevalence in urban Delhi (31%) and a lower prevalence in rural Haryana (8%) using the criteria (WC: >94cm among men and >88 cm among women). The urban slum group in the above study had a prevalence of 12%. Misra et al reported a prevalence of 17% among adults belonging to lower socio economic groups in Delhi using ATP III criteria (100).

A study from Chennai reported a high prevalence of abdominal obesity among adults during 1995 (31%) using modified ATP III criteria (WC: >=90cm among men and >=85 cm among women) (92). The Sentinel surveillance project demonstrated an overall prevalence of 32% of abdominal obesity, using modified ATP III criteria. Dibrugarh in Assam had the lowest prevalence (0.7%)

while Hyderabad in Andhra Pradesh had the highest (52%). North Indian population in Delhi, Lucknow and Ludhiana had a prevalence of 42%, 34% and 17% respectively. Central Indian populations in Nagpur and Pune in Maharashtra had a prevalence of 24% and 34% each. South Indian populations from Bangalore, Trivandrum and Coimbatore had a prevalence of 45%, 32% and 41% respectively. Another study among Industrial population in the Bharat Electronics Limited, Delhi showed a prevalence of 43% among males (24).

Among adolescents and young adults in Delhi, Misra et al and Vikram et al reported a prevalence of 17% (age group 14-18) and 14% (age group 14-25) using the criteria of WC >79cm among males and >76 cm among females (96,101).

Appendix VIII: Systematic Review of Waist- Hip ratio (WHR)

Methodology of Search

Prevalence studies on high waist hip ratio were identified as using the same methodology described previously. The search terms used were “prevalence”, “overweight”, “obesity”, “waist-hip ratio”, “coronary”, “hypertension”, “high blood pressure”, “glucose abnormalities”, “dysglycaemia”, “diabetes”, “insulin and metabolic syndrome” and “India”.

Characteristics of identified articles

Using the above literature search techniques described earlier, we identified eleven epidemiological studies published between 1993 and 2004. Similar inclusion criteria were utilized as for other reviews. All the studies identified were cross sectional in nature. Of the eleven studies, one study was multi-centric and another one addressed the issue of obesity among adolescents. Comparison of obesity among different socio economic, urban-rural differences and slum vs. non-slum differences were available with one study each.

The most common definition used of WHR to define overweight/ obesity has been among males >0.9 and females >0.8. Other definitions used were males >0.95, females > 0.8; males >0.86, females >0.84; males >=0.87, females >=0.85 and males >0.9, females >0.85. These studies were predominantly done in urban areas. Appendix VIIIa shows the study location (urban vs rural), age group studied, sample size, criteria for diagnosis of high waist-hip ratio, prevalence of high WHR in the total group, men and women separately.

Prevalence:

The ICMR Task force project reported 65% prevalence of high waist hip ratio in urban Delhi and 52% in rural Haryana in 1994 using the criteria (WHR: M->0.9, F->0.8). Serial epidemiological surveys in urban Rajasthan had shown the prevalence at 60% during 1994, 63% during 2001 and 79% during 2003 using the criteria (WHR: male->0.9, female->0.8) (7, 77). During 1993, rural Rajasthan had a prevalence of 21% (WHR: male->0.93) (102). In 2002, Reddy reported 74% prevalence of high waist hip ratio among workers of a political party in Andhra Pradesh (103).

Vikram et al reported 34 % (WHR: male->0.95, female->0.8) prevalence among urban slum dwellers in Delhi during 2000 (104). In Chennai, Mohan et al demonstrated the prevalence of high waist hip ratio (criteria: WHR: M->0.9, F->0.85) higher among middle income groups (29%) compared to low income group (23%) (9). It also showed the prevalence of overweight-obesity to be almost twice among males compared to females in low-income groups whereas in middle-income groups it was almost the same among males and females.

Studies among industrial population (Bharat Electronics Limited, Delhi) shows a very high prevalence (89%) of high waist hip ratio (criteria: WHR: male->0.95, female->0.8) (24). Recent

studies done in Delhi during 2002, among adolescents show a high rate of overweight-obesity (19%) using the criteria (WHR: male->=0.87, female->=0.85) (101).

Appendix IX: Physical activity levels among Indian population

Methodology of Search

Studies on Physical activity levels among Indian population were identified using the 3 databases- EMBASE, INDMED and PUBMED from 1990 to 2004. The search terms used were “physical activity”, “leisure-time exercise”, “sedentary life style”, “prevalence”, “coronary heart disease”, and “India”.

Characteristics of identified articles

Using literature search techniques described earlier, we identified three cross sectional studies and one case control studies published between 1993 and 2004. The population groups involved in the cross sectional studies were industrial employees, and working population (employees of bank, public sector undertakings, software companies, factories, schools and colleges, executives, engineers).

Cross-sectional studies

Few studies have estimated the physical activity levels in Indian population so far. Vaz et al assessed the total and occupational physical activity status of school and college teachers in Bangalore, South India using a validated physical activity questionnaire among a convenience sample of 198 school and college teachers (females =173) (105). The physical activity questionnaire provided information on estimated 24-hour energy expenditure (kJ/day) and Physical activity levels (PALs): a composite index of physical activity computed as estimated 24 hour energy expenditure (24h EE)/estimated basal metabolic rate (BMR). The specific cut-offs used for classification of physical activity levels using PALs were: <=1.4 for sedentary; >1.4–<1.55 for mild activity; >=1.55–<=1.6 for moderate activity; >1.6–<=1.75 for moderately heavy activity; and >1.75 for heavy activity. Table-1 shows the Distribution of estimated daily energy expenditure (kJ $\pm$ SD) across various physical activity domains in male and female teachers and table-2 describes Physical activity pattern among teachers based on Physical Activity Levels (PAL) index. Majority of the individuals indulged in either a sedentary or mild activity (PAL <1.55) and discretionary exercise was lower among women.

Table-1: Distribution of estimated daily energy expenditure (KJ ± SD) across various physical activity domains in male and female teachers

Physical activity domains	Men (n = 25)	Women (n = 173)
24 h energy expenditure	10576 ± 1873	8670 ± 1045**
Occupational	4845 ± 1323	3488 ± 801**
Discretionary exercise	806 ± 1457	259 ± 420**
Household chores	327 ± 570	1405 ± 1003**
Sleep	1793 ± 307	1461 ± 226**
Hobbies	57 ± 113	40 ± 86
'Residual' time	1755 ± 877	1353 ± 731**
*Statistical analysis: independent t-test; *P < 0.05; **P < 0.01* *The difference between the 24 h energy expenditure and the sum of the other domains is accounted for by discretionary activities, which are not 'exercise-related'*.		

Table-2: Physical activity pattern among teachers in urban Bangalore South India (N=198) based on Physical Activity Levels (PAL) index

Physical activity pattern	%
True sedentary (PAL: <=1.4)	12.1
Mildly active (PAL: >1.4- <1.55)	44.5
Moderately active (PAL: >=1.55-<=1.6)	13.1
Moderately heavy physical active (PAL: >1.6-<=1.75)	20.7
Heavily active (PAL: >1.75)	9.6

The same authors published the physical activity levels among working population in Bangalore among a convenience sample of 782 adults (441 women) spanning an age range of 17 to 70 years. The physical activity pattern of each subject was assessed using a standard questionnaire, which provided a measure of overall physical activity computed as the Physical Activity Level (PAL) as well as activity related to specific physical activity domains. In the analysis of the latter, activity within a domain was expressed as MET-minutes, the product of the intensity and duration of activities within the specific activity domain (106). Table 3 summarizes the physical activity patterns of the subjects, stratified for age among females.

Table-3: Physical activity characteristics among females

	Age Groups				
	17-24	25-35	36-45	46-58	>58
Sample (441)	149	124	90	56	22
Body mass index (kg/m^2)	19.8 ± 2.8	21.8 ± 3.2	23.6 ± 4.0	24.2 ± 2.6	24.5 ± 3.7
Discretionary exercise (METS-min/day)	104 ± 201	58 ± 101	79± 134	78 ± 111	98 ± 86
Household chores (METS-min/day)	117 ± 157	317 ± 241	446 ± 246	413 ± 241	306 ± 239
Physical activity level (PAL)	1.49 ± 0.15	1.56 ± 0.15	1.54 ± 0.18	1.54 ± 0.18	1.30 ± 0.13

The Sentinel surveillance on CVD in Indian industrial population assessed the physical activity levels among the female subjects based on their perceived daily physical activity in the past five years. There was a broad heterogeneity in the levels of physical activity depending on the location of the industry. Physical activity levels were generally lower in Industries that were located in highly urbanized metropolitan cities such as Delhi, Hyderabad and Bangalore and higher predominantly semi-urban settings such as Assam and Nagpur and was intermediate in other areas. The figures are listed in table-4. Validation of study of International Physical Activity Questionnaire (IPAQ) was carried out in two centres. The results are to be analyzed.

Table-4: Perceived overall daily physical activity (data from Sentinel Surveillance) among females

Category	Assam	Bangalore	Coimbatore	Delhi	Hyderabad	Ludhiana	Nagpur	Pune	Trivandrum	Lucknow	All India
Very light	2.1	1.1	6.1	3.6	4	22.2	1.1	5.2	12.3	3.2	4.4
Light	10	44.5	50.1	54.4	61.8	11.1	22.1	60.1	51	24.3	40.6
Moderate	86.1	46.8	37.8	40.2	32.7	55.6	76.7	30.9	34.1	69.4	51.8
Heavy	1.7	7.6	6	1.8	1.5	11.1	0.1	3.8	2.6	3.1	3.2
Total	100	100	100	100	100	100	100	100	100	100	100
(N)	1211	785	879	1040	401	9	811	1095	894	748	7873

Physical activity and Risk of CHD

Rastogi et al carried out a hospital based case-control study (an allied study of the large ICMR case control study involving four urban centers) addressing the relation of physical activity and risk of

Coronary heart disease in Indian population (23). Data was collected from 350 cases of acute myocardial infarction and 700 controls between the age group 21-74, matched on age, gender and hospital in New Delhi and Bangalore between Jan 1999 and Jan 2000. The Physical activity levels were assessed using a validated physical activity questionnaire specific for Indian population that focused on occupational, and non-leisure time activities, in addition to leisure-time exercise. It was validated by comparing energy expenditure (determined by questionnaire) with energy intake as measured by 24-hr dietary recalls. In age- and sex-adjusted analyses, people in the highest level of leisure-time exercise (>145 metabolic equivalents [MET]-minutes per day, equivalent to 36 minutes of brisk walking per day) had a relative risk of 0.45 (95% CI: 0.31, 0.66) compared with non-exercisers. A positive association between non-work sedentary activity and CHD risk; people with >3.6 hours per day of sedentary activity (for example, television viewing) had an elevated risk of 1.88 (95% CI: 1.09, 3.20) compared with <70 minutes per day in multivariate analysis. The Relative risk of acute myocardial infarction (AMI) by leisure-time exercise, sedentary activity and by work related activity is given in Table-5.

Table-5: Relative risk of Acute Myocardial Infarction by leisure-time exercise and sedentary activity

Risk factor	Cases (N)	Controls (N)	RR** (CI)	RR*** (CI)	RR+ (CI)
Leisure time exercise					
0 MET - min/day*	189	339	1	1	1
>=145	51	189	**0.45**(0.31-0.66)	**0.51**(0.33-0.78)	**0.44**(0.27-0.71)
Sedentary Activity (Non- Work)					
<70 min/day	73	169	1	1	1
>=215	95	147	**1.58**(1.05-2.36)	**1.67**(1.06-2.63)	**1.88**(1.09-3.21)
Relative risk of Acute Myocardial Infarction(AMI) by work related activity					
Risk factor	**Cases**	**Controls**	**RR** (CI)**	**RR*** (CI)**	**RR+ (CI)**
Duration at work					
0 MET - min/day	87	202	1	1	1
>=491	89	151	1.58(0.97-2.58)	1.51(0.87-2.62)	**1.9**(1.01-3.56)
Duration of standing at work					
0 MET - min/day	152	136	1	1	1
>120	71	102	**1.58**(1.06-2.35)	**1.73**(1.08-2.76)	1.85(1.0-3.12)

Duration of walking at work					
0 MET - min/day	147	329	1	1	1
<=120	74	132	1.31(0.89-1.92)	1.68(0.56-1.64)	**1.88**(1.13-3.12)

**MET min- Metabolic equivalent minutes*
***Age, sex, hospital adjusted*
**** Age sex smoking hospital adjusted*
[+] Controlled for age, sex, hospital, smoking, BMI, WHR, History of hypertension, history of Diabetes, history of high Cholesterol, family history of CHD, Alcohol intake, Education, Income, and being Hindu

Appendix X: Case Studies

Case No.1

KK is a 42 year old female, resident of New Delhi. She belongs to an upper middle class family; she works as a teacher in a government school. In the early hours of 13th of April 2005(at around12 midnight), she developed acute chest pain along with stiffness of hands, arms and back, back pain, vomiting, swelling of hands, heaviness and problem in breathing. Due to uncontrolled symptoms and problem in breathing she was rushed a private practitioner at 10:00 AM who referred her to All India Institute of Medical Sciences (AIIMS). She reported at the AIIMS Emergency and was admitted to the hospital where, a coronary angiography was conducted followed by angioplasty. The treatment had cost her INR 70,000 (approx. 1630 USD). Even though this amount will be reimbursed by the school authorities later, arranging for this large an amount all of a sudden was obviously a problem.

The problem had begun 2 years back when she had occasional heaviness in the chest and breathing problems but she did not pay any attention to it, attributing it to the pollution in the city. Though her father too had expired at the young age of 41 years due to a similar heart problem she did not think that she would develop heart disease. She feels she had this problem because of her excess weight, ignorance and stress. Though prompt action was taken and she was relieved of her symptoms, this illness created chaos in her family. Her children were facing board exams and required support from her and she felt guilty that she could not provide it at the most crucial time of their career.

Case No.2

SS is a 48 year old journalist residing in Agra, about 200 kilometers from Delhi. He belongs to a middle class family, he had a history of hypertension and diabetes for the last 6 months for which he had been taking treatment. He has been a regular smoker for the last 12 years. His work is very stressful and he has to often work long hours. He had been having pain in his arm for the last 5-6 days. He suddenly developed sudden chest pain and sweating on April 19, 2005. Initially, investigations and treatment was begun at the medical college in Agra but they then referred him to AIIMS for further investigations. He is currently undergoing investigations at AIIMS, and has been advised to arrange finances for angiography and possible revascularization procedure. He identifies disruption to the whole family as the major problem due to this illness. He believes work hard (>20 hours of work) tension and sleeplessness as the major cause for his illness.

Case No.3

MC is a 54 year old male working as a police inspector in a neighbouring state of Delhi. He has to travel nearly 500 kms to visit this hospital. He had typical symptoms of a heart attack some days back in his home town where the doctors referred him to AIIMS for further treatment. He had been diagnosed to have heart disease CHD and hypertension 2 years prior to this heart attack. He has had coronary artery disease for the last 2 years. It began with a similar incident 3 years back after which investigations were conducted and he was advised surgery. However, due to lack of funds, he could not undergo surgery then. He was on medication but that did not alleviate his problems and he plans to get his surgery done this time by obtaining loans from his friends to cover the extra expenditure which his employer will not cover. He identifies non vegetarian (he consumed meat every day) and believes this as the main cause of his heart attack.

Case No.4

OPS, a 70 year old male shopkeeper developed sudden chest pain while climbing stairs. Although he was diagnosed to be having MI and advised to go to a bigger hospital by his local doctor, he did not take any medicines for 3 days as there were religious festivals during this period. He also felt that it would not be worthwhile visiting a hospital during the holiday period. 3 days after the attack he came to AIIMS where he was admitted and is being investigated. He is also diabetic. He identifies drinking alcohol to be a factor for his heart attack..

Case No.5

JPS is a 52 year old male and a resident of Bihar (around 800 kms from Delhi). He developed mild chest pain initially followed by severe chest pain a year back. He was taken to a private practitioner who suggested taking him to the district hospital, which was located around 4 kms from his residence. He was then referred to a super-specialty hospital located approximately 100 kms from his residence where an angiography revealed severe blockage of three arteries. Almost 2 and ½ months later, he came to AIIMS (located 800-1000 Kms from his residence) for further check-up. Although he does no report any other problems, his cholesterol levels were found to be high upon investigation.

He has had an angioplasty done for which he had to spend Rupees 115,000 (approx 2500USD) and his monthly expenditure on medicines is around Rs.2000 (USD 45). At such short notice, he had problems in procuring the money but managed it from his friends. He has had to take leave from his occupational activities for the last 1 year and he is not very satisfied with the way his son is handling the business. Earlier he had to come to AIIMS regularly for follow-up but now he comes after 6 months. According to him, if he had realized earlier about prevention of heart disease, he would have taken up yoga and meditation.

Appendix XI: Sentinel Surveillance Systems

The protocol, methods and study tools are available on the website: www.cvdsurveillance.org. Some of the key results of this study are provided below.

Key Results

Demographic Characteristics

Majority of the respondents (48%) were below the age of 40 years with a mean age of 40 years. Mean age varied from 32 years at Nagpur to 45.4 years at Delhi. Only 5 % of the subjects belonged to the 60 plus age group. More than two third of the subjects had at least secondary school education and only 6.5% were illiterate. A third of the study population comprised of both unemployed or retired individuals (10%) and house makers (24%).

Behavioral Determinants

One third of the subjects had history of tobacco use in any form and another 30% of study subjects had been using tobacco regularly. Smoking was the major form of tobacco use, followed by use of snuff and tobacco chewing. Almost 12% of the study subjects used alcohol regularly and another 12.5% of subjects used alcohol occasionally. Majority of the participating individuals reported medium level physical activity.

Anthropometric measurements

The mean BMI was 23.1 Kg/m^2 and the Inter Quartile Range (IQR) was 20.1 Kg/m^2, 23.1 Kg/m^2 and 25.7 Kg/m^2. Overall prevalence of overweight (BMI $\geq$23 Kg/m^2) was 51.3%. The mean waist circumference was 82.9 cm and IQR was 75 cm, 84 cm and 91 cm. Mean WC was significantly different in males (85.0 cm) and females (79.9 cm). Prevalence of abdominal obesity among men (WC>94 cm) was 18.4% and among women (WC>88 cm) was 23.6%.

Clinical measurements

Mean SBP was 125.4 mm of Hg and mean DBP was 78.8 mm of Hg. Both mean SBP and DBP increased with age. The prevalence of hypertension by JNC VIII criteria was 27.7%. The prevalence of diabetes by WHO criteria was 10.1% (11.2% in males and 8.2% in females) and the prevalence of impaired fasting glucose (IFG) was 6.4% (7.3% in males and 4.9% in females).

Biochemical Measurements

Mean total cholesterol and mean HDL cholesterol were 176.6 mg/dl (177.1 mg/dl in males and 175.7 mg/dl) and 43.3 mg/dl (42.2 mg/dl in males and 45.3 mg/dl in females) respectively. Mean total cholesterol increased with age where as HDL cholesterol had no linear relationship with age.

Metabolic syndrome

Almost one fifth of the study subjects had metabolic syndrome. Metabolic syndrome prevalence in females (22.1%) was higher than that in males (16.9%). Diabetes, hypertension and metabolic syndrome prevalence increased with age. Dyslipidemia prevalence also increased with age till 60 years of age.

Changes in lifestyle in the sentinel population:

As compared to the baseline survey, at the end of one year, overall physical activity level and fruits and vegetable consumption among the study subjects increased by 17.1% and 36.3%, respectively. Almost one third (31.3%) of the study population reported conscious effort to decrease oil/ghee/butter consumption since the baseline survey. However, no significant difference in prevalence of tobacco consumption was observed from the baseline survey results.

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